Cornell/Penn State High Tunnel Plastic Covering Study 2007 Summary

Introduction

In 2007, four different 6 mil plastic materials were trialed on four research sized (17' x 36') high tunnels at the High Tunnel Research and Education Facility, Penn State University. Two crops were grown and evaluated to compare the differences between the plastics; four varieties of bell pepper and four varieties of long stem sunflower. Yield data was taken on these crops. Digital sensors were also used in each high tunnel to record air and soil temps as well as PAR light readings.

Methods

The study from 2006 was replicated in 2007 with two changes in plastic cover material. The Tufflite Control and Tufflite IR plastics from 2006 were left on the tunnels, and two new materials were used in 2007; one 6 mil Solaroof material and one 6 mil Smartlite Red colored plastic. Onset HOBO data loggers were used in each of the four tunnels to collect air temperatures at 3ft and 6ft. Two soil sensors recorded data from the middle of the high tunnel, and a photosynthetic light sensor (PAR) was placed a few inches from the plastic inside the top of the tunnel.

Four varieties of Colored Bell Peppers were grown; 'King Arthur', 'Gourmet', 'Early Sunsation' and 'Blue Jay'. Crop yield was graded by size and weighted. All peppers were harvested at 50% color or more.

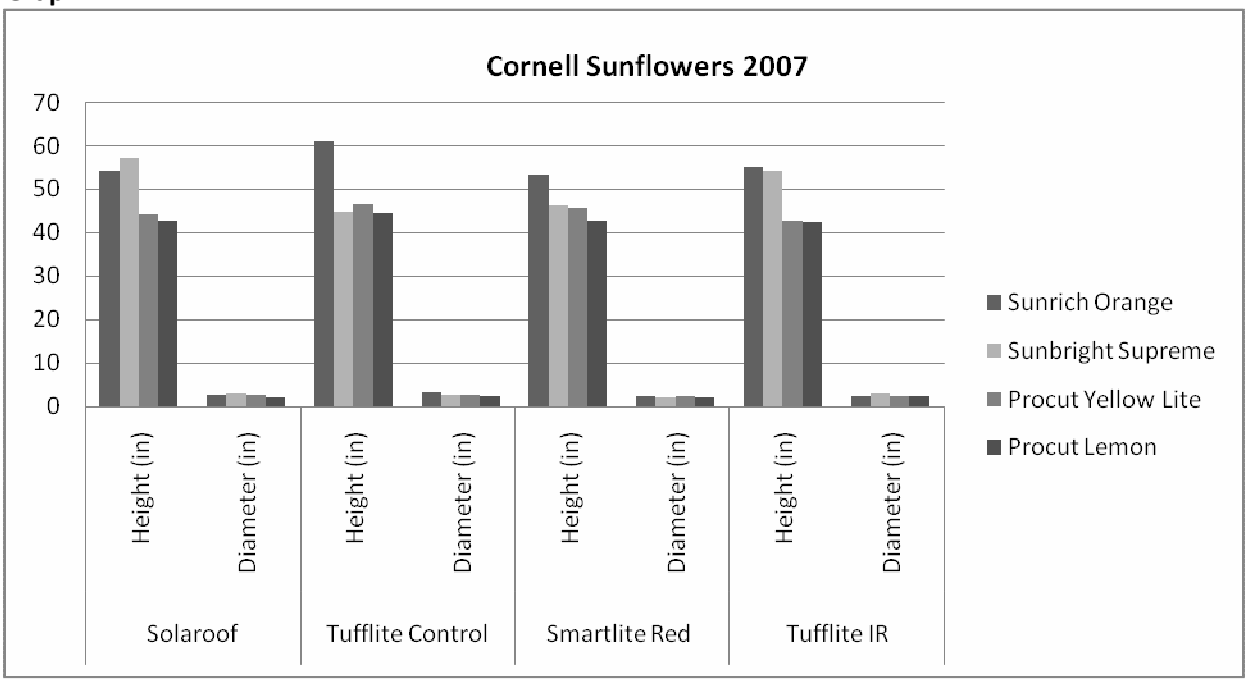
Four varieties of Sunflowers were also grown; 'Sunbright Supreme', 'Sunrich Orange', 'ProCut Lemon' and 'ProCut Yellow Lite'. Height data and disk diameter was taken on the sunflowers.

Results

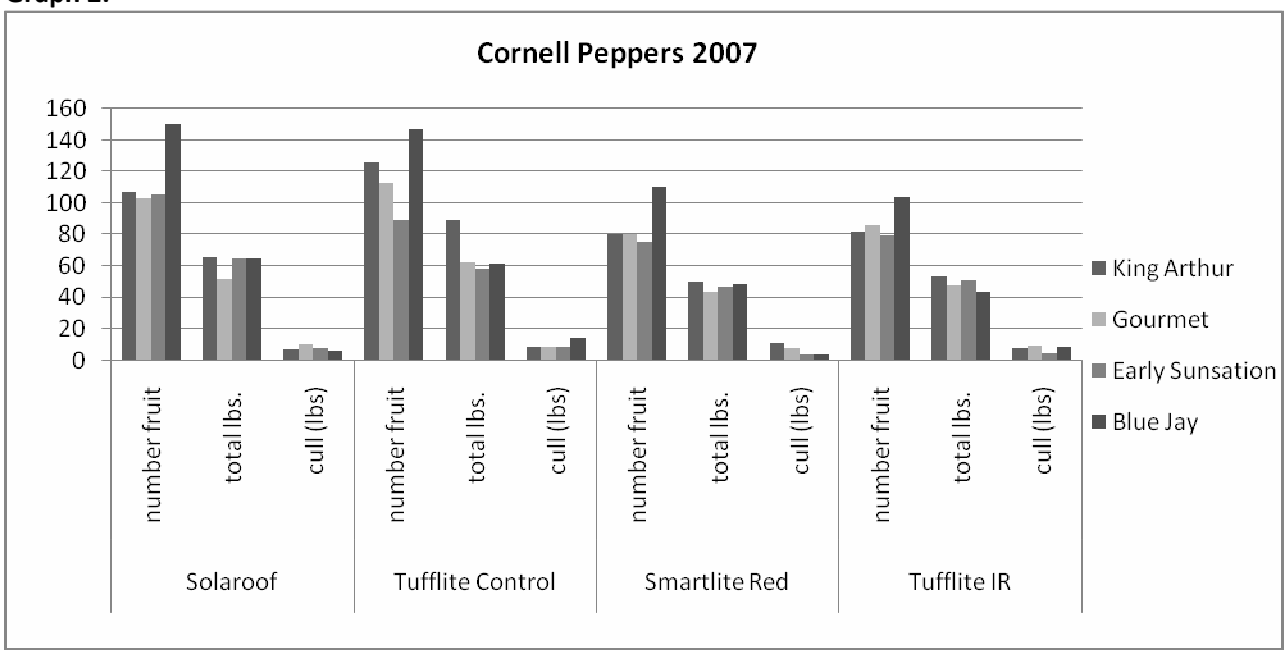
Table 1:

Sunflowers	**Solaroof**		**Tufflite Control**		**Smartlite Red**		**Tufflite IR**	
	Height (in)	**Diameter (in)**	**Height (in)**	**Diameter (in)**	**Height (in)**	**Diameter (in)**	**Height (in)**	**Diameter (in)**
Sunrich Orange	54.0	2.8	**60.8**	**3.1**	53.3	2.4	55.0	2.5
Sunbright Supreme	**57.0**	**3.0**	44.8	2.6	46.3	2.2	54.0	2.8
Procut Yellow Lite	44.1	2.5	**46.6**	**2.8**	45.5	2.4	42.7	2.5
Procut Lemon	42.6	2.2	**44.4**	2.2	42.5	2.0	42.5	**2.3**

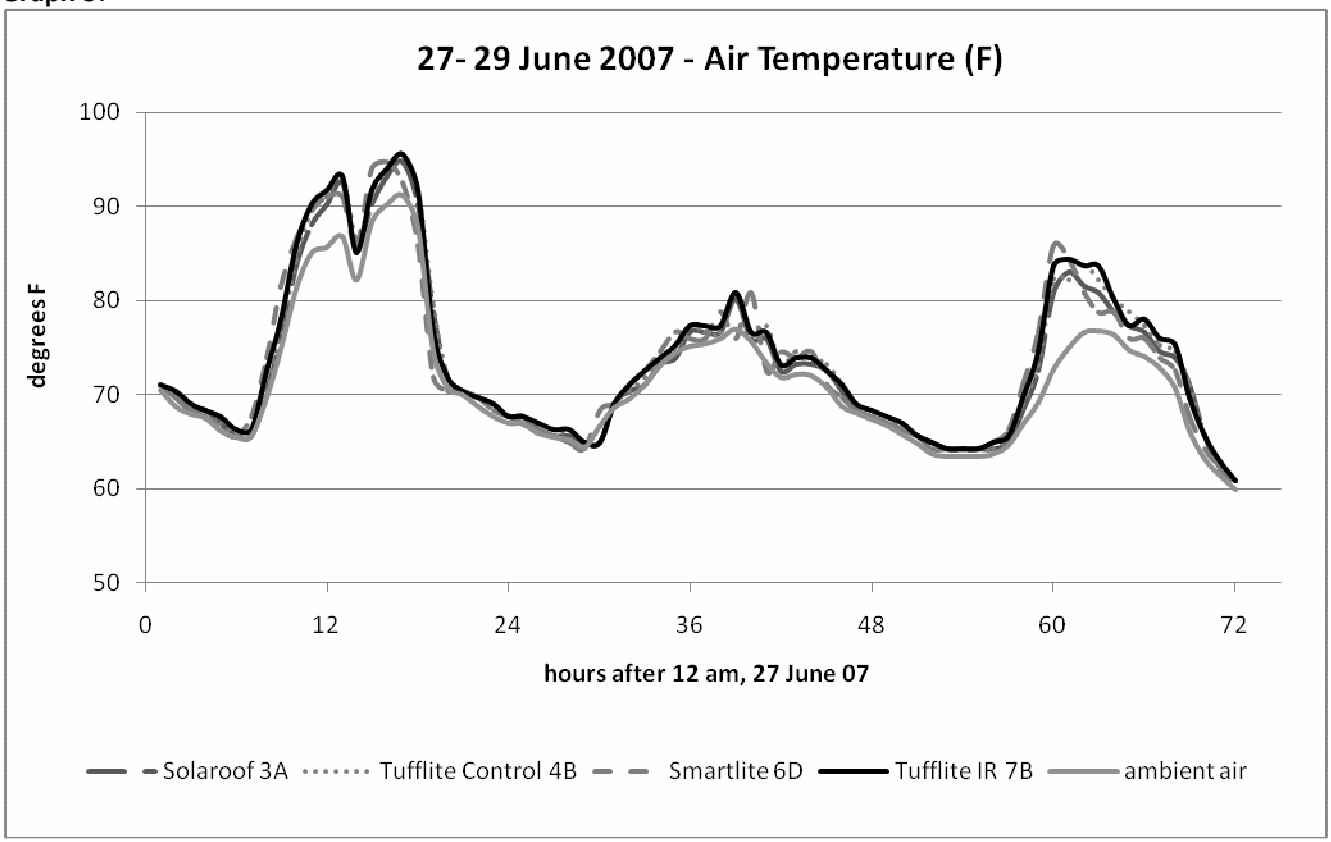
Graph 1:



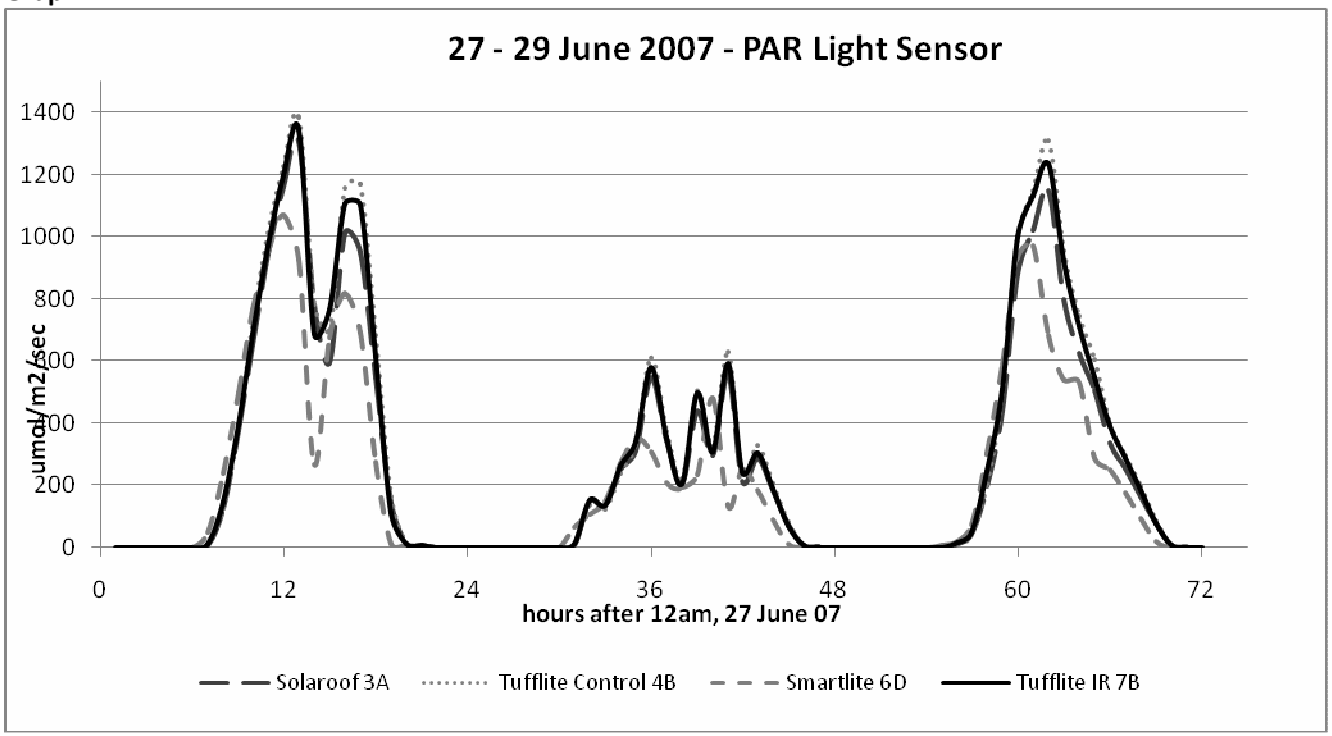
Graph 2:



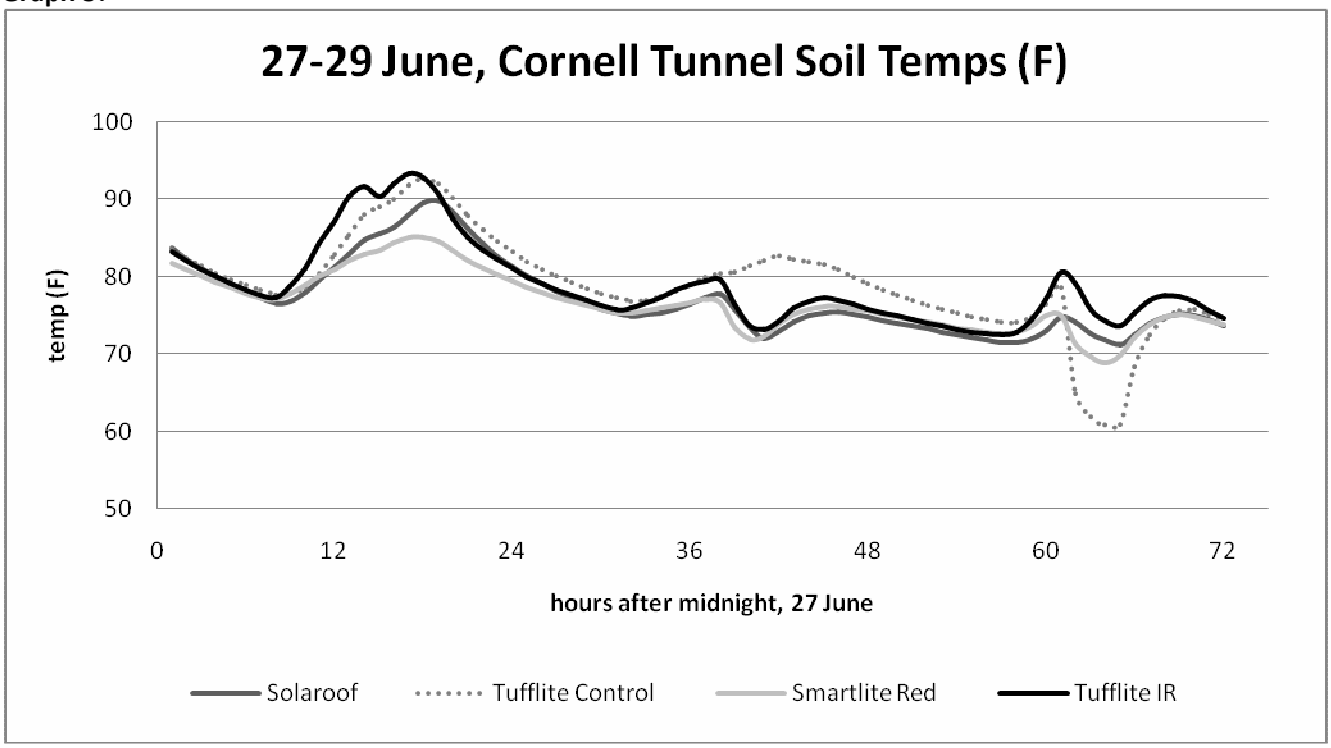
Graph 3:



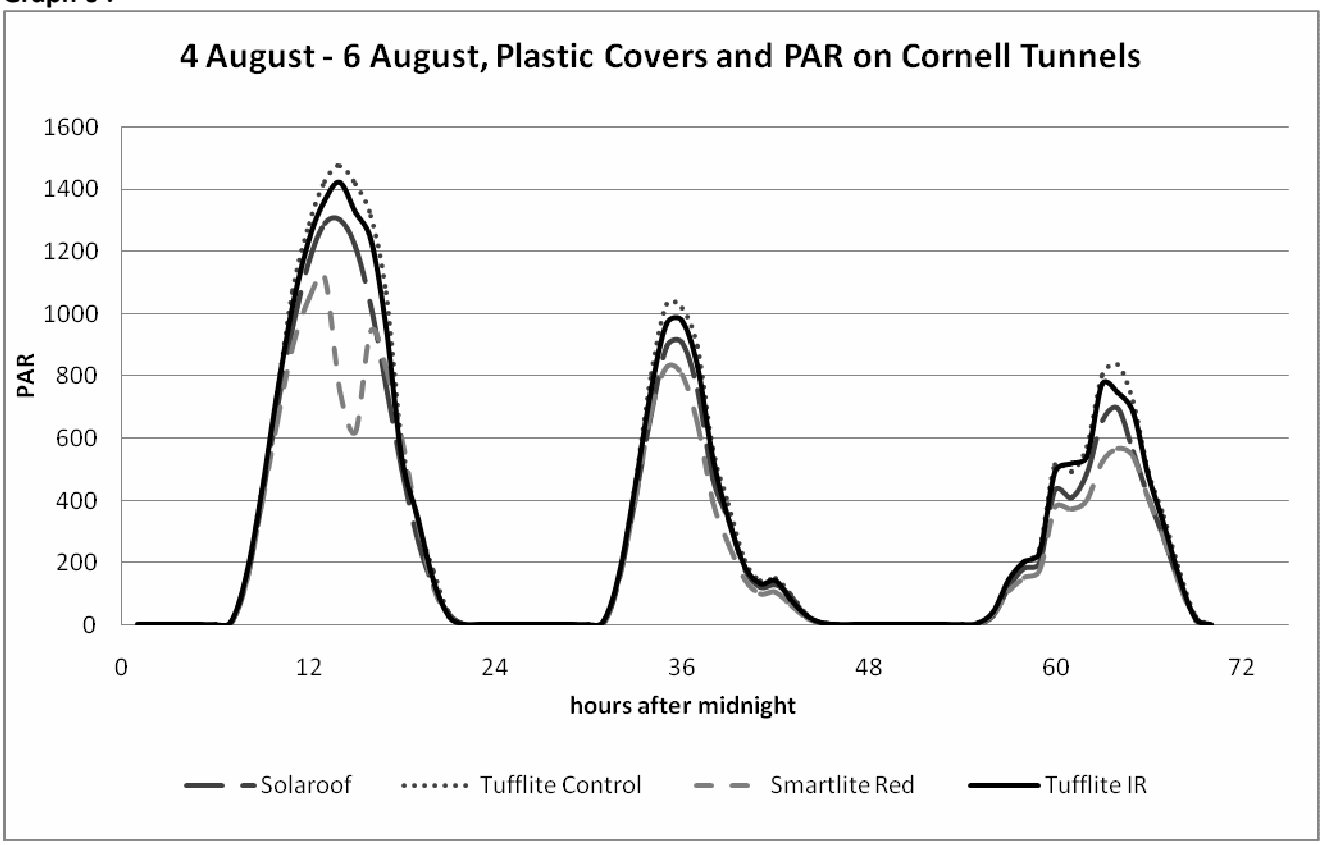
Graph 4:



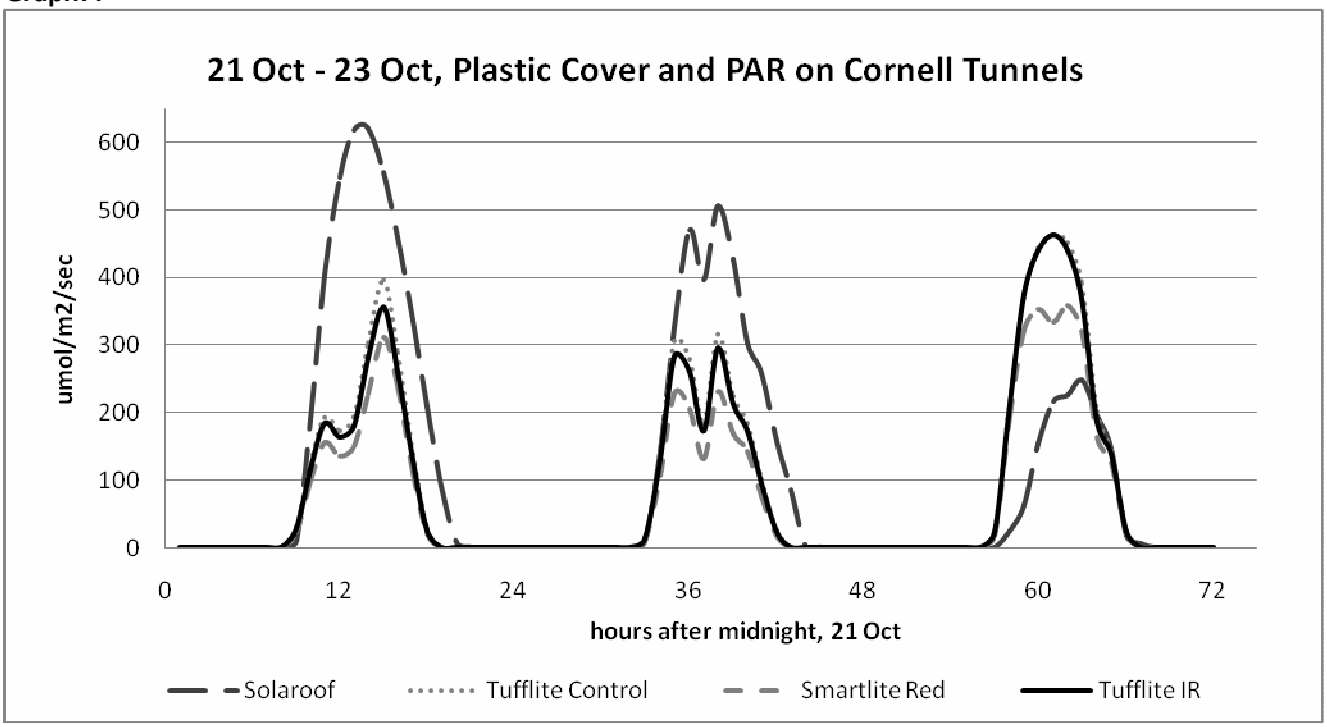
Graph 5:



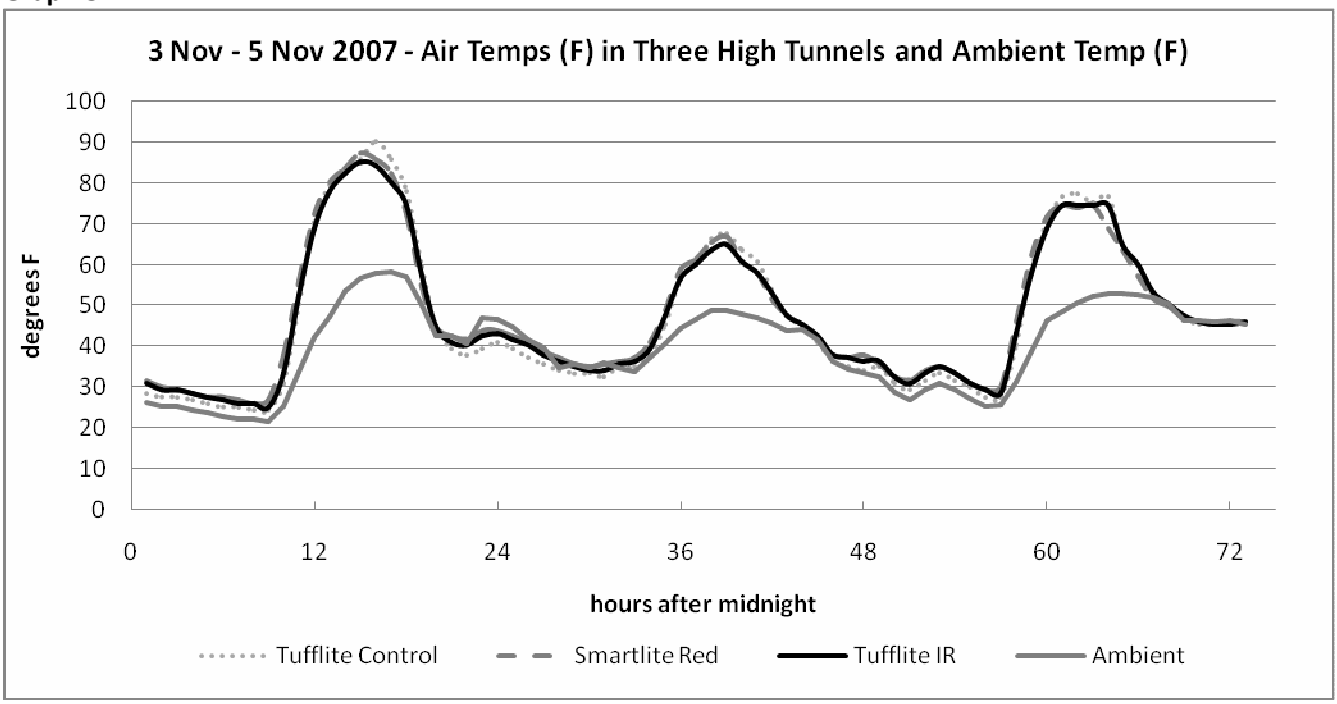
Graph 6 :



Graph7:



Graph 8:



Discussion

Overall, the sunflowers performed better in the tunnels with either the Tufflite Control plastic or the Solaroof material according to Table 1. Although there is no one plastic that overwhelmingly produced taller or larger disk sunflowers, as Graph 2 displays. Graph 3 shows that, again, Soloroof and Tufflite Control produced more bell peppers, with the Smartlite Red producing the fewest total pounds of peppers. It was noted, empirically, that both the sunflower and bell pepper plants were physically much smaller in the high tunnel with the Smartlite Red plastic covering.

Graph 3 ,4 & 5: Graph 3, 4 & 5 compare temperature and soil readings with the corresponding PAR readings. This illustrates that although there are not big differences in temperature on any given day, there do seem to be differences in PAR readings as well as soil temps; especially with the Smartlite Red and Tufflite Control plastic. The light levels in the Smartlite Red tunnel are consistently lower than in the other three tunnels.

Graph 6: This graph illustrates the difference in PAR on three summer days. Although there is a varying degree os light over the three days, the tends are the same. The Smartlite Red plastic tunnel shows the least amount of PAR then the other plastics.
However, this trend is not consistent over time. As Graph 6 shows, in the fall, as the light levels are lower and temperatures decrease, a more erratic pattern is present.

Graph 8: Temperature Inversion? As Graph 8 illustrates on the night of 3 November 2007 (24 hours after midnight), the inside high tunnel temperature is lower than the ambient temperature outside. This occurred in the 2006 study as well. It was hypothesized that there was not a sufficient amount of moisture in the tunnel after the 2006 crops had been removed. This moisture could, hypothetically, hold in more heat, and therefore have a great potential to radiate the heat back into the tunnel at night. It was determined that after the 2007 crops were removed, the black plastic mulch would stay in the high tunnels and would continue to be watered throughout the fall, thus increasing the amount of heat that could potentially be stored in the soil. However, even with the increased amount of water in the soil, the high tunnel temperature still fell below the ambient temperature outside.
Note: Due to intermittent faulty HOBO data loggers, some data is absent.

Conclusion

The trends in the behavior of the different plastic coverings seem to change from season to season. For this reason, it is difficult to recommend one plastic over another. Each plastic may have attributes for one season and one crop, but this is not a sustainable model when including crop rotation and multiple crop and season growth within one high tunnel.