Application of phytolamps with different spectral composition of radiation for vegetable cultivation in artificial lighting conditions.

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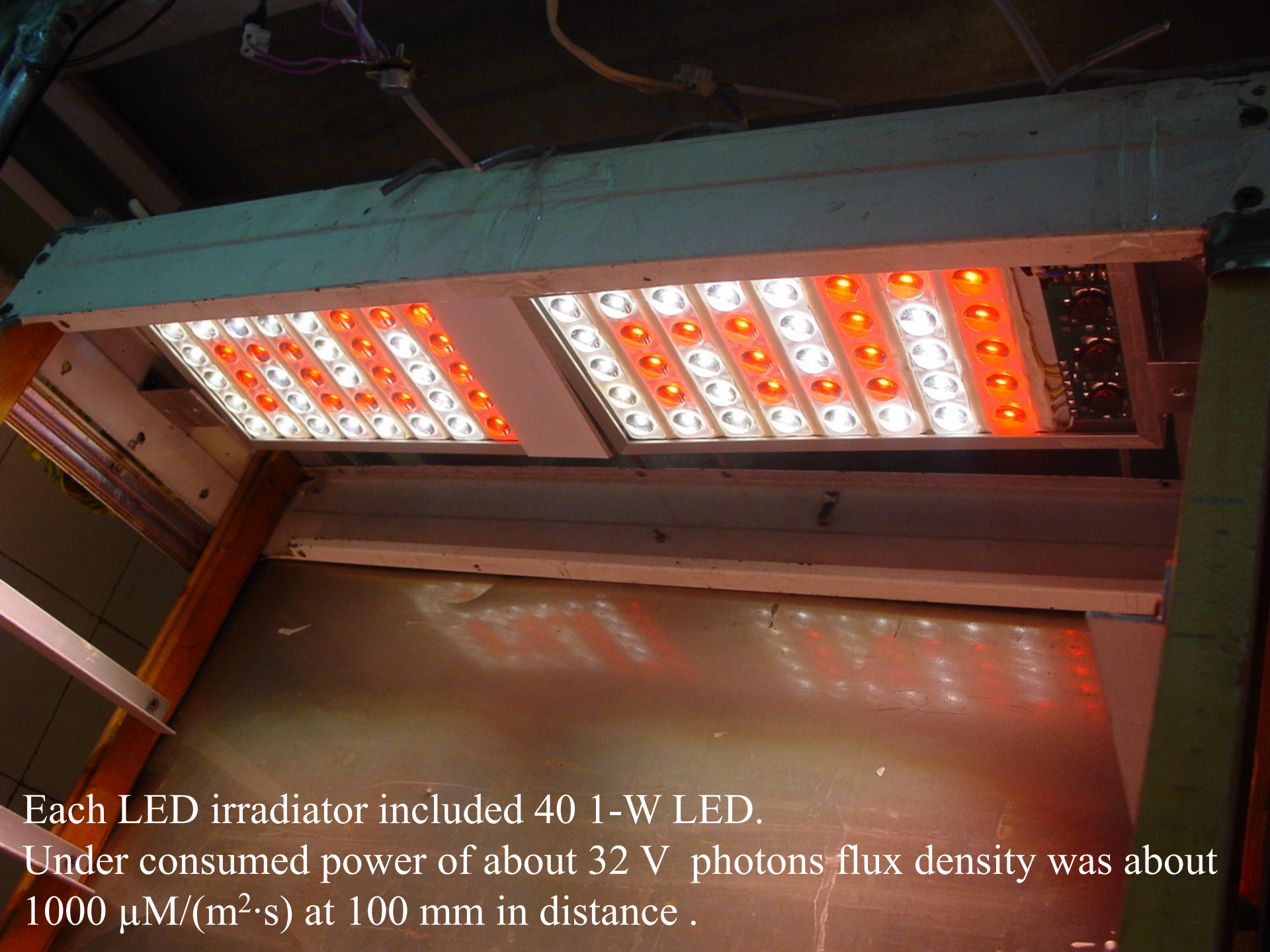
The experiment for cultivation of vegetables (tomato) is carried out in artificial lighting conditions on base of National Academy of Science of Belarus in Minsk since December 2009.

The aim of this research is to find efficient irradiation regimes, making possible specific culture maximum crop capacity realization.

Special LED with different combinations of red, white and blue LED modules were produced for this experiment.



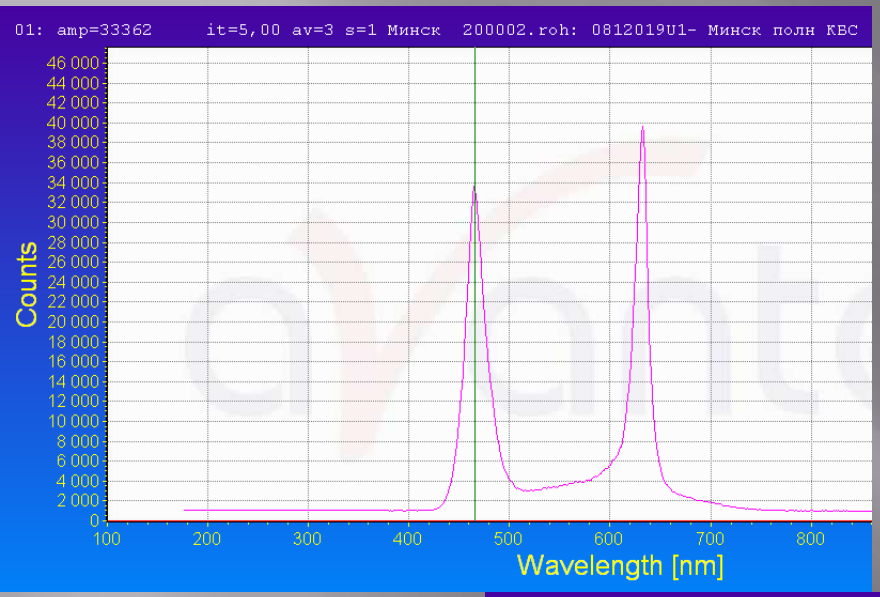
Each LED irradiator included 40 1-W LED.
Under consumed power of about 32 V photons flux density was about 1000 μM/(m^2·s) at 100 mm in distance .

There was used a pulse nutrition of LED.
LED of each color have their own nutrition series separately controlled.

Each LED has external lens for peripheral irradiation dispersion diminution.

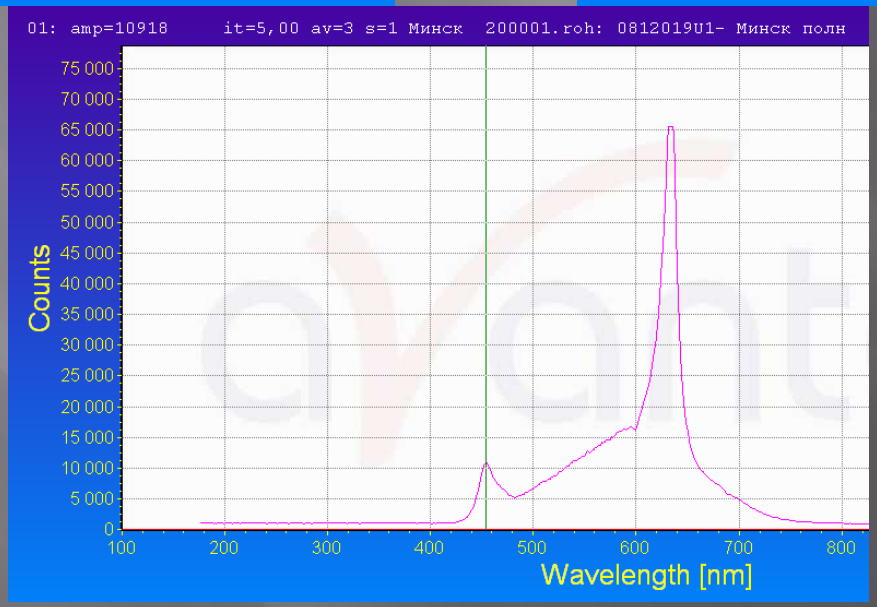
Irradiators have radiative cooler for heat rejection.

Lamp spectram with different LED combinations



White, red and blue LED (10 +23+ 7)

White LED (40)



White-and-red LED (22 +18)

The object of this research are tomato plants (*Solanum lycopersicum*), hybrid «Gironimo» of Dutch selection. Plants were grown on mineral cotton wool in six separated boxes under LED irradiators, differing by their spectrum and intensity.

The control in 7^{th} box was a crop under specialized fluorescent lighting «Sylvania Gro-lux T5L8» with general radiation bands in blue (430-490 nm) and red (630-670 nm) part of spectrum.

Nutrition regime of all plants was the same.

Air temperature was constantly kept -17˚C (dark) and 22˚C (light),

Air humidity - 60-70%,

concentration CO_2 - 900ppm

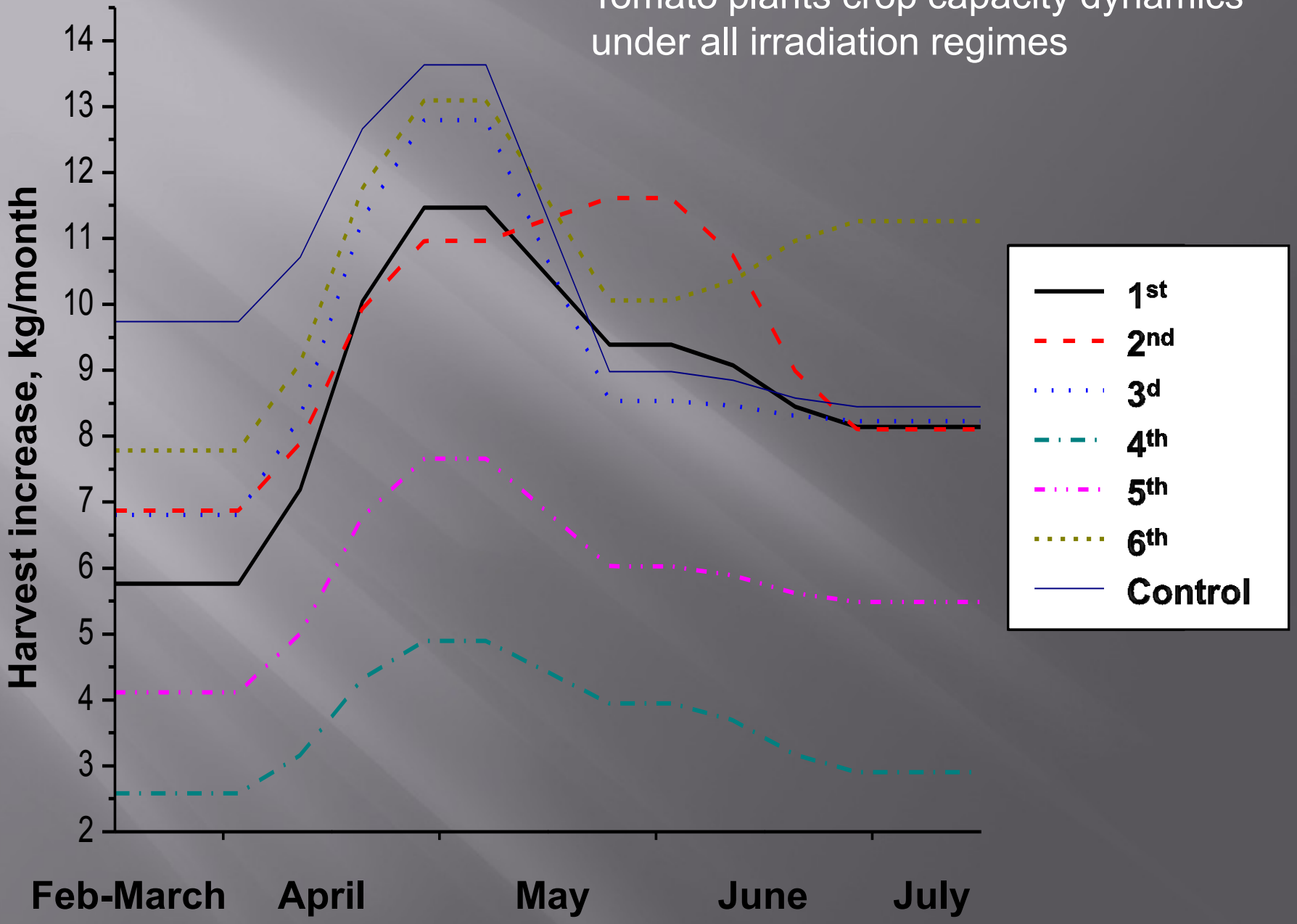
photoperiode -18 hours.


Grotop
Grotop

Variants of all experiments are in the table .

Indices	Variants of experiment						
	1	2	3	4	5	6	7
light-emitting description, ratio of PPF in red (600-700 nm) and blue (400-500 nm) parts of spectrum	1,6:1	2,3:1	4,4:1	2,3:1	2,3:1	2,8:1	3:1
Photons flux density, μM/(m^2 s)	320	320	320	160	240	400	320
Consumed power, kW	0,57	0,56	0,55	0,34	0,45	0,67	0,95
Photons energy consuption, kW/hour	10,26	10,08	9,90	6,12	8,10	12,06	17,1

Tomato plants crop capacity dynamics under all irradiation regimes



Conclusions

Crop capacity under LED as the only light source
is comparable with the tomato plants crop capacity under fluorescent lighting, and also with productivity of plants, grown in hothouse conditions with High pressure sodium lamp use in common with sunlight.

The findings demonstrated a necessity in future optimization of emission spectrum.
At present they hold a fitting out of experimental base with improved spectral features LED modules.