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THE IMPACT OF FLUCTUATIONS IN SPECTRUM AND INTENSITY OF RADIATION ON PLANT PRODUCTIVITY

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Abstract: The article considers the question of the influence of the fluctuations of the spectrum and the intensity of radiation on the productivity of plants

Keywords: irradiation facilities, economic efficiency, stabilization

So far not developed a clear methodology for assessing the impact on plant productivity fluctuations in the spectrum and intensity of radiation. Therefore, when engineering parameters of limit ourselves with regard to material and energy losses caused by the overconsumption of electricity, the increase in installed capacity and a shorter lifespan.

In accordance with the stated [7] the method was carried out to evaluate the efficacy of devices of stabilisation in the breeding complex of the all-Russian Institute of plant industry (VIR). The complex includes 3,000 hectares of breeding greenhouses and more than 30 chambers of artificial climate. With more than 70% of electricity consumption accounted for irradiation facilities. To assess the effectiveness of the use of statistical characteristics of voltage deviation on the buses of the transformer substation of the complex. Given the preliminary information of the voltage measurement was carried out in the range of 0...20% of nominal. The probability of the monitored signal in the interval P(x)and standard deviation σ(x)is determined cyclically in General, per day and for three time intervals of 8 hours. The measurement results are shown in table 2.2. The mathematical expectation of the deviation of the voltage during the day amounted to 24.5, which corresponds to the voltage of the control point network 404,5 V. the Values of mathematical expectations of power consumption, reduction-of-life HL, the variances of the irradiance lamps and spectral ranges are given in table 1

Table 1 - Mathematical expectation of deviations of the main parameters of irradiation facilities breeding complex VIR

Parameters	Type discharge lamp			
	ДМ4-6000	ДРИ-2000	ДНаТ-400	ДРЛФ-400
Voltage deviation, %	6,3	6,3	6,3	6,3
The increase of power consumption and energy consumption, %	17	15	16	18

The reduction of the lifetime of HL %	20	18	18	18
The deviation of the radiation spectral ranges, %				
400 - 700 нм	32	28	26	22
400 -500 нм	20	19	24	—
500 - 600 нм	24	22	16	—.
600 - 700 нм	79	68	35	—

Analysis of the data obtained shows a significant (up to 18%) energy overuse with a decrease in the service life of the GL by 18–20%. In climatic structures, the instability of UQ leads to disruption of the conditions of biological experiments due to the fluctuations of the spectrum and the intensity of HH radiation. The mathematical expectation of the variance of the HEADLIGHTS was 22–28% nominal. In this case, the deviations of the radiation of the blue, green and red spectral ranges reach, respectively, 24, 22 and 68% of their nominal values.

It can be noted that the compensation of deviations Uc will reduce electricity consumption by more than 25% and reduce the annual need for lamps by 20%. When designing irradiation facilities for greenhouses and SCS, the instability of Uc is taken into account in the accepted safety factor, the value of which reaches 1.5 [6]. Thus, additional losses are obtained due to the overestimated installed capacity of the irradiation facilities.

Table 2 - Baseline data for calculating the economic efficiency of stabilization of the parameters of the irradiation facilities of the climate chambers of the breeding complex VIR (for 1 camera)

Power supply conditions	Nominal	From the network
Installed power GL, kW	9	9
Number of lamps (DRLF-400), pcs.	18	18
Power consumption kW	9	11.5
The number of hours of work per year, hour.	5000	5000
Lamp life, hours	6000	4800
Number of replacement lamps, pcs. in year	15	18
Electricity consumption, kW * hour	45000	57500

In the course of the research, an assessment was made of the damage caused by the instability of Uc and a feasibility study was carried out to stabilize the parameters of irradiation units of the type УОРТ-1-6000 and УОРТУ-2-3000 with DM4-6000 and DMZ-3000 lamps. As in the design of irradiation systems, the actual conditions of their operation are not known in advance, the magnitude of the voltage deviations was taken in accordance with existing norms and standards. Thus, the overuse of electricity and the drop in the life of the lamps caused by their operating conditions were not taken into account.

In [8], it was shown that the amount of additional installed GL power to ensure a guaranteed minimum irradiance of HEADLIGHTS when Uc is unstable is determined by the power deviation coefficient of the CU. 28 Thus, with fluctuations in Uc within ± 5% of U and ensuring the normalized integral level of the HEADLIGHT is not lower than the specified, the installed power of the GL is overestimated by 28%. In this case, the power consumption with Uc fluctuations from 0.95 UH to 1.05 will vary from 1.14 P to 1.42 P. At the same time, the effective return decreases

by 10–15% and the terminal parameters of the radiation regime are not supported. The economic efficiency of the use of stabilization devices for irradiation facilities of the type UORT-1-6000 and WART-2-3000 was calculated for a seating area of 1000 m2. In this case, in accordance with the initial requirements [7], it is assumed that devices are individually installed in each control cabinet, i.e., one device for one DM4-6000 lamp or two DM4-3000 lamps.

The baseline data for calculating the economic efficiency of stabilizing the parameters of the IRT-1-6000 irradiation units are given in Table 3 Their analysis shows the possibility of reducing the installed power and power consumption by about 25%.

Thus, the compensation of deviations of Uc in existing SCS will allow to obtain an economic effect by reducing power consumption and increasing lamp resources. The introduction of devices, stabilization at the design stage of the SCS irradiation plants provides savings by reducing the installed capacity of the GL.

Table 3- Baseline data for calculating the cost-effectiveness of stabilizing the parameters of irradiation installations UORT-1-6000

Light zone	1		2		3		4	
Power supply conditions	Nomi-bulk	From the network	Nomi-bulk	From the network	Nomi-bulk	From the network	Номи-нальные	From the network
Irradiated area, m2	1000	1000	1000	1000	1000	1000	1000	1000
Number of units, pcs.	22	28	14	18	13	16	9	11
The area irradiated by one lamp.m2	26	36	72	56	78	63	111	91
Number of lamps, pcs	22	28	14	18	13	16	9	11
Power of installations, kW	132	168	84	108	78	96	54	66
The number of hours of work per year, hour	400	400	400	400	400	400	400	400
Electricity consumption. kWh	52800	67200	33600	48200	31200	38400	21600	26400

Conclusion: an additional economic effect can be obtained by meeting the spectral composition and intensity of radiation technological requirements.

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