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INFLUENCE OF STERILIZATION OF *SITOTROGA CEREALELLA* Ol. EGGS ON BIOLOGICAL INDICES AND EFFICACY OF *TRICHOGRAMMA*

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Key words: *biological indices, prolificacy, pests, Trichogramma, Sitotroga cerealalla, entomophagous*

INTRODUCTION

One of the procedures to increase *Trichogramma* vitality is obtaining biological material of sterile inset eggs. There are several factors of host eggs' sterilization that allow improving insect development oofage: using low temperatures, thermo procedure, ultraviolet irradiation (Voegele, Daumal, 1974), irradiation with gamma rays (Gavrilitsa, 1993, Gavrilitsa L.,1995, Gavrilitsa, 1996, Gavrilitsa, Greenberg, 1996, Gavrilitsa, 2002, Lysikova, 1985) etc. At our discretion obtaining anytime host eggs as a result of their longer storage has favored settling the issue. Agnomens grain moth (*Sitotoga cerealella* Ol.) can not be stored for a long time in a refrigerator. This problem is particularly acute in biological laboratories where it is necessary to prepare big quantities of host eggs parasitized by *Trichogramma* (Burzinski, Kot, 1963; Mencher, Rusnak, Taritsa, 1980) and it has been shows that irradiation of *Sitotoga cerealella* Ol. eggs has a positive effect on reproductive indices of *Trichogramma* developing on them. Similar indices have been obtained when *Trichogramma* developed on cabbage moth eggs irradiated with X-rays (dose of 15 krad) (Degtyarev, Yanishevskaya, 1985).

Special prolongation of shelf life for irradiated eggs for their parasitizing by Trichogramma (up to 12 days) as compared to 2-3 days of non-irradiated eggs has allowed reducing the number of eggs required for parasitation with *Trichogramma* (Gavrilitsa, 1995). Still lacked are data on usage of fresh *Sitotoga cerealella* Ol. eggs gamma irradiated with the aim of their long – term storage and possibility of subsequent *Trichogramma* development on them. Scientific research conducted at the Institute of Genetics, Physiology and the Plant Protection Institute has allowed us establishing that a technique for improving *Trichogramma* quality consists in rearing it on gamma irradiated eggs of *S. cerealella* (Gavrilitsa, Greenberg, 1996). Taking into consideration research tasks the developed technique has demonstrated prospects of rearing the entomophage on gamma radiated eggs of the *S. cerealella*. In this connection rearing the parasitoid on gamma radiated eggs of *S. cerealella* has improved biologigal indices of the entomophage by 1.5-2 times. Research results obtained by Lidia Gavrilita have shown that gamma irradiation of *S. cerealella* eggs at the age of 24 hours allows increasing the term of host eggs storage at the temperature of 3oC up to 4-5 months for subsequent *Trichogramma* rearing. Such rearing of *Trichogramma* on gamma radiated eggs of *S. cerealella* has contributed to improvement of its biological indices by 1.5-2 times. Sex ratio has played an important role in regulating population density. Bibliography on the subject has shown that changing *Trichogramma* spp. sex ratio impacts a number factors such as temperature, humidity, a number of developing larvae per egg, host species and their age, term of storing *Trichogramma* in diapauses and many other (Gavrilitsa, Greenberg, 1996). Bibliography on the subject shown, proves that biological indices of the parasitoid are directly proportional to the host species, its age and egg number (Gavrilitsa, 1996). While conducting biological and ecological research and evaluating results traditional methods have been used as well as specific techniques designed for specific experience while collecting and identifying *Trichogramma* species and *Trichogramma* rearing, determining biological indices and biological efficacy of the entomophage.

MATERIALS AND METHODS

Determination of shelf life of irradiated *Sitotroga cerealella* Ol. eggs in plastic bags.

Mathematical data processing has been done using variance analysis method after (Mencer, Zemshman, 1986). In experiments have been used fresh eggs of the Angoumois grain moth (*S. cerealella* Ol.) at the age of (24 -28 hours), if possible, under mass rearing conditions, gamma irradiated at the dose of 150 Gy. After a certain term of storing eggs of the *S. cerealella* in the refrigerator at the temperature of 3OC ± 1, biological indices have been determined for *T. evanescens* (prolificacy, hatching, females' rate) reared on these eggs. The best results with prolificacy of *Trichogamma* have been obtained applying the irradiation dose of 150 Gy to the eggs of the *S. cerealella*. After determining

the optimal dose for irradiating eggs of the *Sitotroga cerealella* in subsequent experiments the dose of 150 Gy has been applied to eggs. Collecting, identification, storage and accumulation of *Trichogramma* species were done using (according to), (Diurici, 2008). Rearing of the aboratory host – grain moth (*Sitotroga cerealella* Ol.), for *Trichogramma* production was done by (Abaşchin et al., 1997) authors' methods.

RESULTS AND DISCUSSIONS

Table 1, fig. 1 shows results of storing irradiated eggs of the Sitfor 157 days in plastic bags (5 x 5 cm) and check where eggs of the *Sitotroga cerealella* Ol. have been neither irradiated nor stored. After irradiating eggs of the *S. cerealella* at the dose of 150 Gy and placing them into plastic bags to be stored for 32, 65, 102, 136, and 157 days, biological indices of *T. evanescens* have been determined.

Prolificacy of *Trichogramma* reared on *S. cerealella*) eggs soon after irradiation has constituted 43.0 eggs per female, in the check – 24.7, prolificacy in the trial with irradiation has been two times higher than in the check. It eloquently explains that irradiated eggs of the Angoumois grain moth have contributed to improving *Trichogramma* prolificacy. In 32 and 65 days of storing eggs of the *S. cerealella Trichogramma* prolificacy has remained at almost the same level as at the beginning (41.8; 38.5), though considerably higher than in the check (21.7; 21.3). According to criteria T, static data have been accurate to the level of 95 %. In 102 days no essential differences have been revealed between the irradiation variant and the check. In 136-157 days *Trichogramma* prolificacy in the variant with essential irradiation has been much less than in the check and equaled respectively to 17.8 and 4.76 eggs per female, in the check – 22.2 and 18.0 eggs per female. The obtained results have shown that eggs of the *S. cerealella* at the age of 24 hours, gamma irradiated to accumulate eggs, can be stored up to 102 days (3-4 months) in the refrigerator at the temperature of T=3^{O}C. Embryo in the irradiated Angoumois grain moth has died and this has allowed parasitizing and rearing *Trichogramma* for a longer time and increasing its prolificacy**.** It has been found that female longevity increased by 2-3 times (Table 2) in the variant, where *Trichogramma* has been reared on irradiated eggs as compared to the check when *Trichogramma* has been reared without radiation. When *Trichogramma* has been developed on irradiated *S. cerealella* eggs and stored in the refrigerator, its average longevity has equaled to 7 days, in the check – to 2.1 days, when stored for 82 days, respectively – to 4.8 days in the variant, in the check – to 2.2 days, when stored for 103 days 2.2 days in the variant and 1.7 days, respectively. Table 3 shows biological indices of *Trichogramma* reared on irradiated Angoumois grain moth eggs stored for 2 months in plastic bags (5 x 10 cm). *Trichogramma* stock generation (F_0) has been reared on irradiated *S. cerealella* eggs, while subsequent six generations have been reared on non-irradiated eggs. When comparing F_0, F_1, F_2, F_3, F_4, with the check increase by 1.5-2 times has been found in the static criterion and quality, in general, while generations F_5, F_6 have demonstrated no essential differences. *Trichogramma* quality has increased in generations (F_1 to F_6) reared on irradiated eggs compared to F_0, that may be explained by physiological changes in *S. cerealella* eggs caused by gamma irradiation at the doze of 150 Gy.

Determining storage period of the Agnomens grain moth (*Sitotroga cerealella*) eggs

Irradiated *Sitotroga cerealella* eggs have been stored for five months in small glasses with the volume of 50 ml. Every month irradiated and stored eggs have been exposed to parasitizing by *Trichogramma* followed by determining biological indices in order to reveal optimal terms for storage of irradiated eggs. Table 4 shows static criterion of *Trichogramma* quality reared on stored irradiated *S. cerealella* (variant) and on non-stored Angoumois grain moth eggs (check). According to the obtained data, quality static criterion of eggs irradiated and stored for one month has been by 2.6 times higher and when storing for two months – by 1.8 times higher, for three months – by 1.5 times higher, for four months – by 1.5 times higher, for 5 months – by 1.34 times higher. The longer is the storage period the less is the biological index of *Trichogramma*. Mathematical processing and analysis of variance have shown that according to T - criterion statistic data have been accurate at level of 95 %. Difference of quality static criterion of *Trichogramma* reared on irradiated *S. cerealella* eggs stored for five months as compared to the check has been essential and $T_{0,05}$=2,23<T_f=6.587-15.428. Irradiated *S. cerealella* eggs can be stored in glasses for five months with essential differences as compared to the check.

Determining efficacy of *Trichogramma* generations. Table 5, fig. 2 gives graphical representation of biological indices of *T. evanescens* reared on irradiated and non – irradiated *Sitotroga cerealella* Ol. eggs. While comparing biological indices of *Trichogramma*, reared on *S. cerealella* eggs from the stock generation (F.) with 12 consecutive generations reared on irradiated and non-stored it has been shown that they are two times higher in the variant with radiation than those in the check. Prolificacy has varied in 12 generations from 31.1 to 42.1 in the variant with radiation and from 19 to 22 in the check and the static criterion of quality in the variant with irradiation from 15.5 to 19.6 and from 8.7 to 9.8 in the check. Comparison of variant generations F_1 – F_{12} with those in the check have shown considerable difference, where $T_{0,05}$ = 2.78; $T_{1\text{-}12}$ = 5.9-50.9 at the level of 95% accuracy $F_{practical}$ = 58 >$F_{theoretixal}$ =7.7.

Table 1. Influence of gamma radiation of the *Sitotroga cerealella* Ol. eggs on biological indices of *T. evanescens*

Ref. No.	Variants	Storage time, days	Average prolificacy, eggs / female	Hatching per individual, %	Confidence interval	Stiudent criteris of assessment - T
1.	150 Gy	0	43.0±14.8	97.7±13.8	(36.38; 49.52)	$t_{f} = 4,13 > t_{0,05} = 2,04$
2.	Check	0	24.7±10.4	94.7±12.8	(19.37; 30.04)	
3.	150 Gy	32	41.8±12.6	96.1±10.8	(36.53; 47.2)	$t_{f} = 6,40 > t_{0,05} = 2,04$
4.	Check	0	21.7±3.4	93.2±9.8	(20.01; 23.38)	
5.	150 Gy	65	38.5±9.9	96.3±10.6	(33.84; 43.16)	$t_{f} = 6.52 > t_{0,05} = 2.04$
6.	Check	0	21.3±3.8	96.4±10.7	(19.44; 23.16)	
7.	150 Gy	102	25.7±5.6	94.4±9.8	(23.13; 28.27)	$t_{f} = 1.3 > t_{0.05} = 2.02$
8.	Check	0	23.0±4.5	92.2±9.3	(21.10; 24.80)	
9.	150 Gy	136	17.8±3.1	89.2±9.2	(16.56; 9.03)	$t_{f} = 2.31 > t_{0.05} = 2.01$
10.	Check	0	22.2±6.4	88.2±8.8	(19.47; 24.92)	
11.	150 Gy	157	4.7±1.36	83.0±7.2	(3.84; 4.96)	$t_{f} = 2.89 > t_{0.05} = 2.01$
12	Check	0	18.0±6.3	87.2±7.8	(15.45; 20.55)	

Table 2. Longevity of *Trichogramma* females reared on irradiated and stored eggs of the *Sitotroga cerealella* Ol.

Variant	Storage period	Female longevity (days)
150 Gy Check	48±2.36 0	7.0±0.8 2.1±0.1
150 Gy Check	82 ±3.32 0	4.8±0.6 2.2±0.2
150 Gy Check	103±3.36 0	2.1±0.1 1.7±0.3

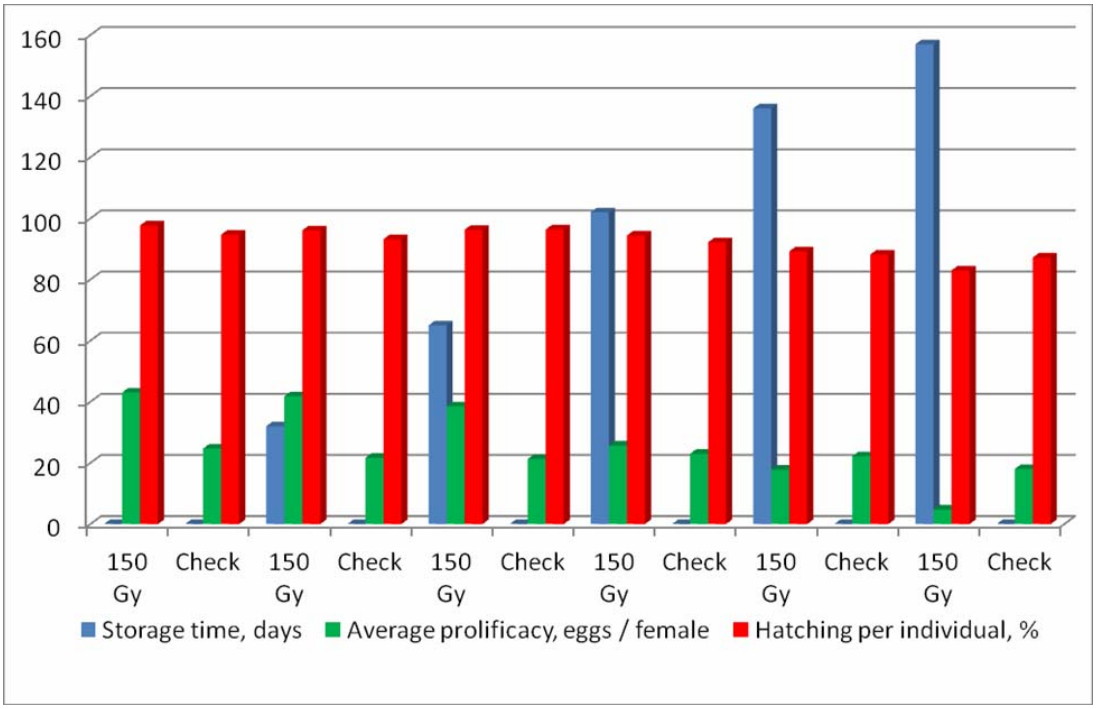

Fig. 1. Influence of gamma radiation of the *Sitotroga cerealalla* Ol. eggs on biological indices of *Trichogramma evanescens.*

Tabele 3. Biological indices of *T. evanescens* reared on eggs of the *Sitotroga cerealella* Ol. stored for 2 months

Biological indices	Value of biological indices by generations													
	F_0	M	F_1	M	F_2	M	F_3	M	F_4	M	F_5	M	F_6	M
Prolificacy, egg/female, (P)	30.0	22.0	34.2	22.1	35.8	22.1	28.6	20.0	32.4	20.0	25.7	20.0	18.7	18.0
Individual hatching, % (α_1)			85.0	85.5	87.6	85.0	88.1	85.5	84.6	80.0	81.3	80.0	80.6	81.0
Error	1.1	0.001	0.9	4.6	2.6	4.6	2.8	0.43	2.0	0.43	0.88	0.43	6.5	0.51
Females hatching, % (α_2)			53.0	53.0	53.4	52.9	52.5	51.0	53.6	53.7	54.0	53.7	54.0	52.0
Static criteria of quality (γ_1)			15.4	10.0	17.2	10.0	13.2	8.6	14.2	8.6	11.2	8.6	8.0	7.6
Error			0.68	0.001	0.19	0.002	0.9	0.17	0.2	0.17	0.41	0.1	0.17	0.2
Searching capacity, % (γ_2)			33.4	20.4	33.0	22.8	28.0	20.8	22.0	20.4	24.0	20.4	25.0	21.0
General criteria of quality, (*D*)			0.55	0.25	0.59	0.26	0.44	0.24	0.31	0.24	0.34	0.24	0.33	0.23
Error			0.006	0.001	0.01	0.03	0.2	0.005	0.1	0.005	0.005	0.005	0.01	0.003

F_0 – storage of eggs of the *S. cerealella* irradiated for 2 months. $F_1 – F_6$ – *Trichogramma* reared on non-irradiated *S. cerealella* eggs, six generations; M – check

Table 4. Static criteria of quality of *Trichogramma evanescens* reared on irradiated eggs of *Sitotroga cerealella*

Variant	Storage term (months)				
T.evanescens reared on irradiated eggs of *Sitotroga cerealella*	1	2	3	4	5
Static criteria of quality of *Trichogramma evanescens* reared on irradiated eggs	23.4±1.2	17.1±1.0	13.5±0.8	12.7±0.8	11.6±0.7
Error	1.74	0.94	0.29	0.25	0.20
Dispersion	9.60	2.63	0.26	0.19	0.12
Check (on non-irradiated eggs)	1	2	3	4	5
Static criteria of quality of *Trichogramma evanescens* reared on non-irradiated non-stored eggs	9.02±0.8	9.2±0.9	8.6±0.7	8.4±0.8	8.7±0.8
Error	0.005	0.10	0.45	0.025	0.10
Dispersion	0.0001	0.02	0.40	0.001	0.02

Table 5. Static criteria of *Trichogramma evanescens* quality

Static criteria of quality	Generations											
	1	2	3	4	5	6	7	8	9	10	11	12
Development of *Trichogramma* on irradiated eggs of the *Sitotroga cerealella*	17.0± 1.8	16.5± 1.3	16.0± 1.1	16.9± 1.2	16.2± 1.4	15.2± 1.2	15.1± 1.1	16.2± 1.0	19.2± 1.8	16.9± 1.5	17.9± 1.2	17.0± 1.4
Development of *Trichogramma* on non-irradiated eggs (check) of the *Sitotroga cerealella*, 12 generations	10± 1.4	9.8± 1.0	9.9± 1.1	10,2±. 5	9.8± 1.0	9.8± 1.1	10± 1.3	9.8± 1.2	9.5± 1.1	10± 1.0	9.8± 1.3	9.7± 1.2

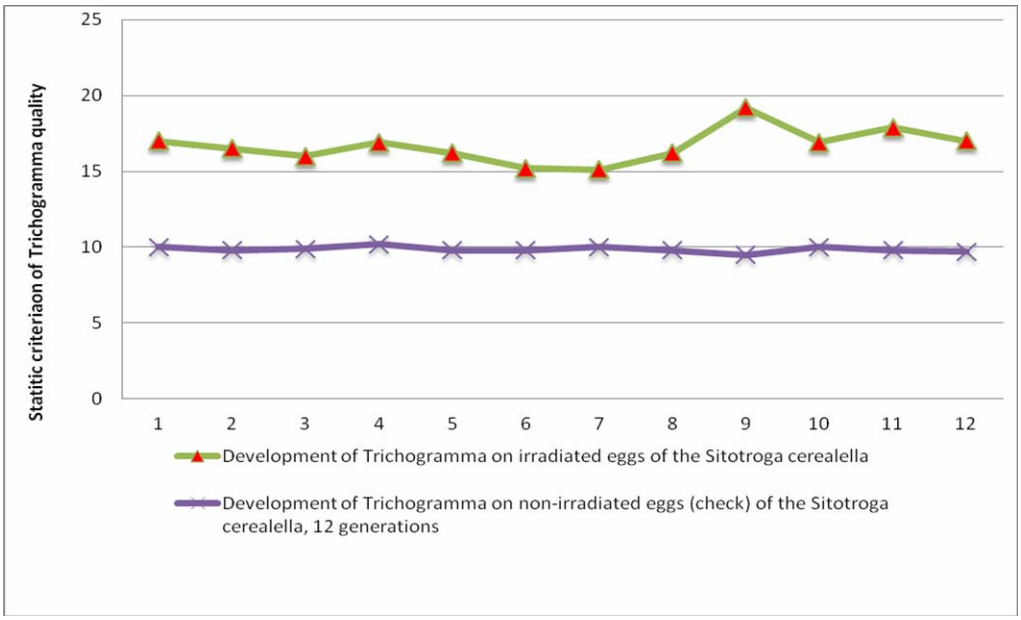

Fig. 2. Static criteria of *Trichogramma* quality (Y_1) by generations

CONCLUSIONS

According to available data, the Get variant where au *Sitotroga cerealella* Ol. eggs were irradiated with gamma rays of 150 Gy dose and kept within one month, state quality criteria was 2.6 higher, irradiated and stored in within two months - 1.8 times greater, held within three months - by 1.5 times, held within four months - by 1.5 times, held within five months - 1.34 times higher, as the witness. The terms of storage are higher, the smaller the biological indices of *Trichogramma*.

Mathematical processing, analysis of variance indicated that the criterion - T statistics are accurate at the 95%. Static quality criterion *Trichogramma* difference, multiplied by *Sitotroga cerealella* Ol. eggs. irradiated were kept five months, further propagation of *Trichogramma* compared to the control is essential higher (T0,05 = 2.23 <Tf = 6.58 to 15.43).

ABSTRACT

According to available data, the Get variant where au *Sitotroga cerealella* Ol. eggs were irradiated with gamma rays of 150 Gy dose and kept within one month, state quality criteria was 2.6 higher, irradiated and stored in within two months – 1.8 times greater, held within three months - by 1.5 times, held within four months - by 1.5 times, held within five months 1.34 times higher, as the witness. The terms of storage are higher, the smaller the biological indices of *Trichogramma*. Mathematical processing, analysis of variance indicated that the criterion – T. statistics are accurate at the 95%. Static quality criterion *Trichogramma* difference, multiplied by *Sitotroga cerealella* Ol. eggs. irradiated were kept five months, further propagation of *Trichogramma* compared to the control is essential higher (T0,05 = 2.23 <Tf = 6.58 to 15.43).

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