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EFFICIENCY OF SOME PLANT POWDERS IN COMBINED WITH RADIATION AS SEED PROTESTANTS AGAINST INFESTATION BY PULSE BEETLE *Callosobruchus maculatus* (F.)

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ABSTRACT

The efficiency of gamma radiation (20 and 40 Gy) either alone or in combination with some plant powders (soybean and lupine) at ratio of 4% (w/w) on protecting pulses against *Callosobruchus maculatus* has been studied. Generally the mortality percentage of adults increased as the radiation dose was increased from 20 to 40 Gy. Combination of soybean powder and (40 Gy) gamma radiation highly effect than either separate treatment. The radiation doses tested significantly decreased the total number of eggs per female. However, when plant powders combined with gamma radiation have caused highly significant decrease in the eggs number. Gamma radiation alone or combined with plant powders was highly effective in decreasing the adult emergence, while the percentage of males emerged increased. Radiation was significantly increased the developmental period as compared with that of the control. The combination of soybean and radiation caused highly significant prolongation when reared on faba bean.

INTRODUCTION

C.maculatus is important pest which cause serioue damage of pulse seeds and considerable losses if not adequantely controlled. The application of ionizing radiation for controlling insect infesting stored products appears promising and has some advantage over conventional methods of control (Cornwell and Bull, 1960; Qureshi *et al.*, 1970; Brower, 1975; El-Degwi, 1983 and Ahmed *et al.*, 1993). The potential hazards for mammals from synthetic insecticides, the ecological consequences and the increase of insect resistance to insecticidies have necessitate the search for more safe and less expensive method of control from various sources. Natural products are considered one of the most promising control agents.Such agents may be used as repellents, antifeedants, inhibiting multiplication of storage insects and provided good example in this respect (Ladd *et al.*, 1978; Golob and Webley, 1980; El-Nahal *et al.*, 1989; Risha *et al.*, 1990; Mostafa, 1993; El-Degwi and El-Orabi, 1996 and El-Degwi, 1997).

Researches is currently conduted on the biological activity of plant as natural source of insecticides. With this outlook the present study was conduced to evaluate the efficiency of certain plant powders in combination with gamma radiation in biological aspects of *C. maculatus* for protecting pulses.

MATERIALS AND METHODS

The parental insects (obtained from a standard culture reared in Insect and Pest Control Lab., NCRRT) were reared on the host seeds, cowpea *(Vigna unguiculata),* faba bean (*Vicia faba*) and chick pea (*Cicer arietinum*) in an incubator maintained at 30 ±2 ^{0}C and 70 ±5% relative humidity. This stock culture was used in all experiments which were also performed under these controlled conditions. Radiation of insects has been attempted through Gamma Cell Irradiation Model 220 Unit (^{60}Co source located at the NCRRT with a dose rate of 2.6 rad/sec.) The irradiation dose level used were 20 and 40 Gy for newly emerged adults.

The test seeds, lupine (*Lupinus vulgaris*) and soybean (*Soja max*) were ground to fine powder (60 mesh sieve) by using an electric grinder and mixed with 25 gm of host -seeds at ratio of 4% (w/w) in 250 ml jars. Ten irradiated pairs of adults were transferred to each jar, covered with muslin cloth. Each treatment and control were replicated five times. The jars were daily investigated for 15 days to determine the number of dead adults, number of eggs laid per female and number of emerged adults. Adults mortality was corrected by Abbott's formula (1975). Adult emergence, egg laying, developmental period were estimated and subjected to analysis of variance according to Sinedecore and Cochran (1967).

RESULTS AND DISCUSSION

Results in (Table 1) show that the mortality percentage of *C.maculatus* increased as the radiation dose was increased. The percentages of mortality were (86.21, 80.23 and 74.7%) when reared on cowpea, fababean and chickpea respectively, compared with (12.0, 14.0 and 13.0%) in the control. On the other hand the combination of 4% plant powder and 20 or 40 Gy of gamma radiation increased mortality percentage.

Table (1): Combining effect of radiation and tested plant powders mixed with seeds on the percent mortality of *Callosobruchus maculatus.*

Host seeds Treatments	Cowpea			Faba bean			Chick pea		
	Irrad.	Plant powder+ Irrad.		Irrad.	Plant powder+Irrad.		Irrad.	Plant poder+ Irrad.	
		Lupine 4%	Soybean 4%		Lupine 4%	Soybean 4%		Lupine 4%	Soybean 4%
Control	12.000%	39.00%	48.00%	14.00%	28.00%	33.00%	13.00%	37.00%	42.00%
20 Gy	62.07%	86.89%	88.46%	59.30%	83.33%	88.06%	56.32%	84.13%	87.93%
40 Gy	86.21%	91.80%	94.23%	80.23%	88.89%	92.54%	74.71%	90.48%	93.10%

However, the magnitude of 40 Gy combination was higher than that of 20 Gy. This results indicate that the combination of soybean powder and

radiation was highly efficient than separate treatments. El-Degwi and El-Orabi (1996), suggested that soybean powder could be used to reduce infestation of *C. maculatus* in host seeds followed by lupine, fenugreek and kidneybeen powders. Also, El-Degwi *et al.*(2001) found that the combination of radiation with LC_{50} of black pepper powder was generally more effective than either treatment applied alone against *C. maculatus.*

Data presented in (Table 2) show that in all treatments the deposited eggs were drastically decreased to various rates. The radiation doses tested significantly decreased the total number of eggs per female from (135.0, 137.0 and 134.4) for control to (108.2, 107.0 and 112.8) for 20 Gy and (84.8, 70.2 and 65.2) for 40 Gy when reared on cowpea, faba bean and chick pea respectively, it is very important to note that when plant powders combined with gamma radiation caused highly significant decrease in the number of eggs per female, except in the case of lupine powder when reared on faba bean. The least number of eggs (11.6) laid per female was obtained when radiation dose (40 Gy) combined with soybean powder mixed with cowpea seeds. El-Sayed and Adbel Razik (1987), found that oviposition of *Callosobruchus maculatus* was inhibited when bean, soybean and lentils were treated with cotton seed, soybean and ground nut oils. Risha *et al.* (1993b), studied the insecticidal efficiency of lemon and eucalyptus oils on *C. chinensis* and found no toxicity to the adults but showed some effect on oviposition. El-Degwi and El-Orabi (1996), stated that lupine, soybean, fenugreek and kidney bean powders mixed with cowpea, faba bean and chickpea seeds were effective in reducing number of eggs laid by the *C. maculatus* females.

Data in (table 3) indicated that gamma radiation alone or combined with plant powders was highly effective in decreasing the adult emergence. Moreover, the combination of gamma radiation (40 Gy) with soybean powder induced the least number of emerged adults (1.6) when reared on cowpea seeds. Risha *et al.* (1993a) evaluated soybean oil for protecting faba bean and cowpea seeds against *C. chinensis* and found that the high doses (2 and 4 ml/kg) of oil caused a high percentage of reduction in progeny. Many investigators found that powders drived from certain plants (different parst) gave the same effect. Ismail *et al.* (1995) indicated that the orange fruit peel or guava leaf powder was effective in reducing adult emergence of *C. quadrimaculatus* El-Degwi and El-Orabi (1996), mentioned that the high ration (12%) of soybean powder reducing adult emergence of *C.maculatus* from host seeds.

Data also, show that gamma radiation either sparately or in combination with plant powders increased the percentage of males emerged. However, the combination of soybean and 40 Gy gamma radiation decreased the male percentage (57.0 and 46.18%) when reared on cowpea and cheak pea respectively, the same treand was observed when lupine powder was combined with gamma radiation (47.82%) in case of faba bean. Abbass (1993), found that the *Azadirachta indica* seed powder against *Bruchidus incarnatus* decreased drastically adult females. El-Degwi and El-Orabi (1996), recorded that the lowest male ratio was in 4% soybean powder mixed with faba bean, chickpea and cowpea.

3

As shown in (Table 4) the mean developmental period was greatly extended in comparison to the control and as the radiation doses increased, the period was significantly increased. Results obtained show that the combination of soybean powder and 40 Gy of gamma radiation when reared on fababean caused highly significant prolongation (44.8 days)in comparison to the control (28.8days). Ismail *et al.* (1995), found that the development of the larval and pupal stages of *C. quadrimaculatus* was markedly retarded by orange fruit peal powder. El-Degwi and El-Orabi (1996) assessed the efficacy of 4 plant powders against *C. maculatus* on some stored pulses they found that the developmental period of emerged adults was longer than their corresponding control when host seeds mixed with the other powders.

From the results it cauld be concluded that the combination of gamma radiation with soybean powder protecting pulses against bruchids. The great effect of soybean powders may be due to the presence of high protein content which reduced food preference of *C. maculatus* (Singh and Agrawal, 1976 and Anuradha *et al.*, 1991). The combined effect was obvious and this effect is due to that irradiation may alter somatic tissue to extent either decreasing or increasing the efficiency of cells which can detoxify insecticids.

This make it useful to assure complete control of insect population in pulses or to reduce the cost of insect control in large pulses mass.

4

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فاعلية بعض المساحيق النباتية بالمشاركة مع الاشعاع فى حماية الحبوب ضد الاصابة بخنفساء اللوبيا

مى صلاح الدجوى
المركز القومى لبحوث وتكنولوجيا الاشعاع

درس التأثير المشترك للاشعاع ومساحيق بعض الحبوب التى لاتصاب بخنفساء اللوبيا وتعتبر عوائل غير مفضلة ، وقد تم خلط مسحوق الترمس وفول الصويا مع اللوبيا والفول البلدى وحمص الشام بنسبة 4%.

وقد أشارت النتائج المتحصل عليها بعد معاملة الحشرات بالجرعات 20 ، 40 جراى أن نسبة الموت تزداد بزيادة جرعة الاشعاع ، والمعاملة المشتركة بالجرعة 40 جراى ومسحوق فول الصويا كان لها التأثير الاكبر عن المعاملة بكل منها على حدة .

وكانت لجرعات الاشعاع المستخدمة تأثيرا معنويا مرتفعا فى خفض عدد البيض ، كما أن جرعات الاشعاع سواء على حدة أو بالمشاركة مع المساحيق النباتية كان لها تأثيرا معنويا مرتفعا فى خفض عدد الخلفة الناتجة من الجيل الاول ، وكانت النسبة المئوية للذكور الناتجة أكبر .

أحدث الاشعاع زيادة معنوية فى فترة التطور بالمقارنة بالحشرات الغير معاملة وكان للاشعاع ومسحوق فول الصويا معا تأثيرا معنوى مرتفع فى إطالة التطور عندما ربيت الحشرات على الفول البلدى .

Table (3): Combining effect of radiation and tested plant powders mixed with seeds on the mean adult progeny and the emerged males of *Callosobruchus maculatus.*

Host seeds Treatm-ents	Cowpea						Faba bean						Chick pea					
	Irrad.		Plant powder+ Irrad.				Irrad.		Plant powder+Irrad.				Irrad.		Plant poder+ Irrad.			
			Lupine 4%		Soybean 4%				Lupine 4%		Soybean 4%				Lupine 4%		Soybean 4%	
	Mean adult progeny ± S.E.	% of males emerged	Mean adult Progeny ±S.E.	% of males emer-ged	Mean adult progeny ±S.E.	% of males emer-ged	Mean adult progeny ± S.E.	% of males emer-ged	Mean adult progeny ±S.E.	% of males emer-ged	Mean adult progeny ±S.E.	% of males emer-ged	Mean adult progeny ±S.E.	% of males emer-ged	Mean adult progeny ±S.E.	% of males emer-ged	Mean adult progeny ±S.E.	% of males emer-ged
Control	118.6 ± 8.003	50.10	45.0 ± 11.9	55.50	29.4 ± 6.8	63.6	120.8 ± 12.46	56.60	29.8 ± 5.58	55.70	23.2 ± 6.56	55.17	113.02 ± 14.24	52.38	49.8 ± 10.43	52.6	37.8 ± 7.34	53.5
20 Gy	100.4 ± 13.58	58.36	39.4 ± 14.54	59.39	4.6 ± 2.6	68.4	98.8 ± 12.11	62.21	26.4 ± 4.79	59.84	20.0 ± 4.15	59.0	89.6 ± 4.78	58.92	22.6 ± 1.96	67.2	14.6 ± 3.77	57.5
40 Gy	23.60 ± 2.15	78.8	10.80 ± 0.144	62.24	1.6 ± 1.2	57.0	22.4 ± 4.54	76.78	4.6 ± 1.39	47.82	2.4 ± 0.93	66.6	21.6 ± 6.16	74.29	9.2 ± 4.69	67.4	5.6 ± 0.927	46.28
L.S.D. 0.05	23.13		27.37	-	21.158	-	26.11	-	11.055		11.36		23.61		16.87		12.07	

Table (2): Combining effect of radiation and tested plant powders mixed with seeds on the number of eegs laid by female of *Callosobruchus maculatus.*

Host seeds Treatments	Cowpea			Faba bean			Chick pea		
	Irrad.	Plant powder+ Irrad.		Irrad.	Plant powder+Irrad.		Irrad.	Plant poder+ Irrad.	
		Lupine 4%	Soybean 4%		Lupine 4%	Soybean 4%		Lupine 4%	Soybean 4%
Control	1135.0±10.29	78.2±13.4	72.8±15.32	137.0±15.06	54.2±11.01	51.4±8.57	124.4±15.5	75.8±12.62	72.0±14.02
20 Gy	108.2±10.61	51.0±17.51	14.2±1.11	107.0±22.83	45.4±10.50	47.6±6.87	112.8±9.6	37.4±4.0	24.4±4.22
40 Gy	84.8±1.65	24.4±14.4	11.6±0.51	70.2±9.3	31.2±10.86	24.6±4.41	65.2±8.7	21.6±5.24	16.8±3.02
L.S.D. 0.05	21.62	23.09	22.34	42.04	-	17.20	29.37	20.39	21.004

Table (4):Combining effect of radiation and tested plant powders mixed with seeds on the total developmental period of *Callosobruchus maculatus*.

Host seeds Treatments	Cowpea			Faba bean			Chick pea		
	Irrad.	Plant powder+ Irrad.		Irrad.	Plant powder+Irrad.		Irrad.	Plant poder+ Irrad.	
		Lupine 4%	Soybean 4%		Lupine 4%	Soybean 4%		Lupine 4%	Soybean 4%
Control	27.8±0.66	29.6±0509	31.2±0.80	28.8±0.48	32.0±0.54	41.2±0.20	31.4±0.244	33.4±0.74	34.8±0.40
20 Gy	33.6±0.40	34.0±.44	35.8±0.58	34.2±0.583	35.8±0.58	43.8±0.58	34.8±0.58	35.2±0.58	36.8±0.50
40 Gy	35.2±0.58	36.6±0.60	37.6±6.78	38.2±0.681	38.6±0.812	44.8±0.378	35.8±0.58	37.6±0.60	37.6±0.50
L.S.D. 0.05	1.409	1.316	1.744	1.39	1.657	1.048	1.25	1.341	1.267