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Role of Fenvalerate (Pyrethroid) and Cyanox (Organophosphorus) Insecticides on Growth and Some Metabolic Activities During Seedling Growth of *Raphanus sativus* L.

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Abstract: Radish seeds (*Raphanus sativus* L.) were germinated at 25°C on moist filter paper for 5 days under continuous illumination (4000 lux). They were supplemented with 10^{-6}-10^{-3} M concentration of cyanox or fenvalerate separately. Homogenous healthy plants from each treatment were taken for growth parameters. Another group of fresh cotyledons were taken for pigments estimation, some enzymatic activities and some biochemical analysis in the dry matter. In case of treated seeds, shows a significant drop in the percentage of germination especially by largest dose 10^{-3} M of cyanox. The length of the whole plant was significantly increased by both insecticides then dropped by high concentration of them. The fresh weight of treated plants decreased but more prominent by fenvalerate. There is no harmful effects on the pigments except the high dose 10^{-3} M, which decrease ch a to 65% of the control. The insecticides were not suppressive to soluble nitrogen components. The harmful effect was highly apparent on the insoluble nitrogen components and more prominent with the large doses of both insecticides. The treated plants, carbohydrates progressively increased by both insecticides than control. The alkaline phosphatase increased by both insecticides, the reverse was the case in the acid phosphatase.

Key words: *Raphanus sativus*, fenvalerate, cyanox, insecticides, harmful effects

INTRODUCTION

Insecticides are used extensively to control plant pests and vectors of human. Whatever may be the mode of application and whether they are used in agriculture or in public health. Insecticides never remain at the site of application and ultimately sink into the soil. Any changes occurring to the plant as a result of insecticide used is due to the effect on physical and biochemical activity of plant. Organophosphorus insecticides form a largest and most diverse group of insecticides. These compounds have phosphorus as the active nucleus and are esters of alcohols with phosphoric acid or anhydrides of phosphoric acid with another acid (O'Brien, 1967). Synthetic pyrethroids exert a prolonged residual action, opening new possibilities of large scale use in crop protection. The toxicity and the harmful effect of insecticides depend on edaphic condition and/or test plant species. The laboratory research may provide short-term alternatives to chronic toxicity tests and provide basic information that will be helpful in assessing their utility in field applications. In 1981, fenvalerate was recommended for use on tomatoes under suggested Best Management practices implemented by the state. Baloch (1989) studied the effect of 2 pesticides on the growth, fructification and yield of cotton. The different pesticides varied in their effect, some increasing plant height and other increasing the number of branches, leaves, squares, flowers and open bolls per plant, there was no significant difference between treatments in fructification and yield.

The wide application of insecticides was accompanied by potentially hazardous impact on human, animals and plants (Dzwonkowska *et al*., 1991; Salama *et al*., 1991; Diril *et al*., 1990).

The present study was a laboratory trial carried out to illustrate the comparative effect of 2 types of insecticides (pyrethroid compound) fenvalerate and (organo-phosphorus compound) cyanox on the growth, pigmentation and some biochemical analysis of radish seedling.

MATERIALS AND METHODS

Radish seeds (*Raphanus sativus* L.) were kindly supplied by the Agricultural Research Center, Giza. A homogeneous lot of seeds were selected for uniformity of size, shape and viability. These were surface sterilized by soaking for two min in 0.1% $HgCl_2$, after which they were washed several times with H_2O. One hundred seeds of radish in each Petri-plate were germinated at 25°C on moist filter paper for 5 days under continuous illumination (4000 lux).

These were supplemented with different concentrations of cyanox or fenvalerate, ranging from 10^{-6} -10^{-3} M separately. Homogenous health plants from each treatment were taken for growth parameters. Another group of fresh cotyledons were taken for pigments estimation, some enzymatic activities and some biochemical analysis in the dry matter.

The photosynthetic pigments (chlorophyll a, b and carotenoids) were determined by the specterophotometric method recommended by Metzner *et al*. (1965), the amounts are calculated as mg chlorophyll/g fresh weight.

According to Bergmayer's methods (1974) alkaline and acid phosphatases were determined as King Armstrong units/g fresh weight.

Analysis (triplicate samples) of the carbohydrates and nitrogen components were recommended by Naguib (1964, 1969).

RESULTS AND DISCUSSION

Table 1 showed that radish growth responded differently to cyanox and fenvalerate. This preliminary experiment indicated that fenvalerate lowered the percentage germination of radish seeds almost to the same extent irrespective of test concentrations. On the other hand, seed germination was almost unaffected by cyanox concentration in the media except at the largest dose application, where the percentage germination dropped to a far greater extent than in presence of fenvalerate. Table 1 also showed that radicle and hypocotyl length were hardly affected by 10^{-6} M fenvalerate. Larger doses seemed to stimulate significantly at 5% $p<0.01$ radicle more than hypocotyl length, a response that faded (10^{-4} M) or even reversed (10^{-3} M) by increasing fenvalerate concentration. On the other hand, 10^{-6} M cyanox stimulated radicle than hypocotyl length of radish seedlings, a response that was arrested (10^{-5} M) or even reversed by larger dose application significant at 5% $p<0.01$ of the insecticide. Results also show that fenvalerate levels lowered the fresh weight gain by radish seedling about to the same extent regardless of insecticide concentration insignificant; $p>0.05$. The drop was far greater in the radicle than the other seedling components. 10^{-6} M cyanox hardly if at all affected total fresh weight of seedlings but similar to fenvalerate, severely attenuated radicle fresh weight that was compensated by increased weight of the cotyledons. Further increase in cyanox level slightly attenuated, the total fresh weight of the seedling insignificant at 5% $p>0.05$; response thus was furthered by further rise in cyanox level. Still the major drop was in the radicle significant at 5% $p<0.01$ followed by the hypocotyl fresh weight.

The fluctuation in dry weight gain followed those of the fresh weight where the main drop, if any, was in the radicle and cotyledons dry weight gain. Generally length of radicle, hypocotyl increased by low concentration of fenvalerate and cyanox (10^{-5}, 10^{-6}). This is in agreement with the effect of fenvalerate and the synthetic pyrethroid on plant phenology of cotton which revealed that plant height, number of flowers and boll, were higher in the synthetic pyrethroid-treated plots (Khurana *et al*., 1994).

Fenvalerate helped in avoiding 13.9 g yield loss of tomato (Kumar *et al*., 1999). Fenvalerate dusts provided good protection to earlier stages of seedlings growth of maize where they were less effective at later stages, but registered higher yields when compared to the control (Viji and Bhagat, 2001).

Das and Mukherjee (1994) showed a significant increase in rice grains and straw production in fields treated with fenvalerate. Increased production was attributed to fenvalerate's stimulation of N-fixing bacteria and P-solubilizing microorganisms in treated soil.

Generally, there are no significant difference between the fenvalerate and cyanox on the fresh and dry weight of the plant $p>0.05$.

Table 2 shows that neither cyanox nor fenvalerate had a significant effect on either chlorophyll a or chlorophyll b up to 10^{-4} M where chlorophyll b either dropped by cyanox or inversed by fenvalerate. Further increase in concentrations favoured a drop in both chlorophyll, cyanox being more effective than fenvalerate. On the other hand, carotenoids were slightly lowered by cyanox application to almost the same level irrespective of concentration. In the mean time the slight stimulatory effect of fenvalerate on carotenoids concentration was progressively reversed by further increase of the insecticide level above 10^{-6} M. In spite of the low chlorophyll content of the radish cotyledons (at the high insecticides levels) insignificant $p>0.05$. Yet the ratio of chlorophyll a to chlorophyll b was mostly higher than the control in case of cyanox (or low dose application of the insecticides, an indication of the slow rate of transformation of chlorophyll a to chlorophyll b. Bader and Schuler (1996) found that fenvalerate cause inhibition of reactions of photosynthesis electron transport.

Table 3 shows that activity on the whole, either insecticide were suppressive to the accumulation of either components of the nitrogen content of radish cotyledons. The effect was highly apparent on the insoluble than soluble forms and more prominently by large dose application of either insecticides, highly significant $p<0.001$ by fenvalerate. Abdullah *et al*. (2006) found that different insecticides showed differences on total amino acid content of cotton leaves. Fenvalerate treated plant the amino acid being the nearest to the untreated plants.

Table 1: Effect of different concentrations of cyanox and fenvalerate on growth criteria of 5 day old *Raphanus sativus* L. seedlings±SE

	Length (mm)			Fresh weight (mg)				Dry weight (mg)				
Treatment	R	H	T	R	H	C	T	R	H	C	T	G (%)
Control	25.18±1.09	23.46±1.05	48.6±2.14	4.13±0.16	7.73±0.18	25.33±1.7	37.19±2.04	0.41±0.06	0.93±0.08	8.33±0.9	9.67±1.04	99±0.03
Cyanox												
10^{-6}	31.00±1.5	27.91±1.09	58.91±0.59	2.93±0.13	6.67±0.09	28.30±2.01	37.90±2.23	0.33±0.04	0.7±0.090	7.67±0.15	8.7±0.280	98±0.08
10^{-5}	23.21±0.95	25.52±0.87	48.73±1.82	1.97±0.12	5.60±0.80	27.20±1.02	34.77±1.94	0.3±0.090	0.61±0.08	6.67±1.01	7.58±1.18	96±0.09
10^{-4}	21.44±0.94	21.81±0.81	43.25±1.75	1.87±0.25	4.54±0.27	25.33±1.3	31.74±1.82	0.28±0.03	0.54±0.02	6.08±0.07	6.9±0.120	88±1.10
10^{-3}	17.97±0.17	16.44±11.0	34.41±0.28	1.87±0.08	3.47±0.08	23.30±1.99	28.64±0.13	0.28±0.05	0.42±0.94	5.59±0.06	6.29±0.15	70±1.65
Fenvalerate												
10^{-6}	24.71±1.9	25.35±1.03	50.06±0.93	2.27±0.03	7.47±0.20	24.00±0.07	33.74±0.30	0.26±0.04	0.83±0.06	8.07±0.9	9.16±1.00	89±0.90
10^{-5}	36.58±2.01	25.80±1.70	62.38±1.71	2.53±0.06	6.93±0.09	24.30±1.04	33.76±1.19	0.25±0.06	0.75±0.08	7.59±0.04	8.59±0.18	87±0.95
10^{-4}	29.2±1.09	25.18±1.01	54.38±2.10	2.93±0.13	6.40±0.07	23.93±0.03	33.26±0.23	0.25±0.03	0.64±0.06	7.70±0.14	8.59±0.23	89±1.01
10^{-3}	20.63±2.1	21.31±1.70	41.94±3.80	2.00±0.40	5.87±0.60	24.00±1.30	31.87±870	0.24±0.14	0.61±0.09	7.20±0.15	8.05±0.38	84±1.36

LSD 5% = 0.82; LSD 1% = 1.16

Table 2: Effect of different concentrations of cyanox and fenvalerate on pigment content (mg g^{-1} fresh weight) of 5 day old *Raphanus sativus* L. seedlings±SE

Treatment	Ch a	Ch b	Ch a+b	Carotein	Total pigments	Ch a/b
Control	2.20±0.35	1.0±0.18	3.20±0.29	0.87±0.07	4.07±0.13	2.20±0.05
Cyanox						
10^{-6}	2.23±0.04	1.0±0.01	3.23±0.04	0.67±0.01	3.90±0.04	2.23±0.01
10^{-5}	2.40±0.27	1.0±0.02	3.40±0.37	0.63±0.09	4.03±0.22	2.4±0.06
10^{-4}	2.53±0.04	0.7±0.02	3.23±0.13	0.71±0.05	3.94±0.09	3.61±0.03
10^{-3}	1.50±0.02	0.4±0.01	1.90±0.06	0.67±0.04	2.57±0.29	3.75±0.5
Fenvalerate						
10^{-6}	2.3±0.19	1.1±0.02	3.40±0.08	1.01±0.01	4.41±0.03	2.09±0.03
10^{-5}	2.4±0.3	1.0±0.01	3.40±0.04	0.76±0.06	4.10±0.05	2.40±0.04
10^{-4}	2.5±0.05	1.4±0.08	3.90±0.05	0.80±0.09	4.70±0.16	1.78±0.02
10^{-3}	1.7±0.03	0.9±0.07	2.60±0.29	0.52±0.21	3.12±0.4	1.89±0.01

LSD 5% = 1.26; LSD 1% = 1.71

Table 3: Effect of different concentrations of cyanox and fenvalerate on some nitrogen fractions (mg g^{-1} dry weight) of 5 day old *Raphanus sativus* L. cotyledons±SE

Treatment	Peptide	Amino acid nitrogen	Total soluble nitrogen	Total insoluble	Total nitrogen
Control	1.37±0.02	2.23±0.29	6.72±0.17	51.67±1.1	58.39±0.16
Cyanox					
10^{-6}	1.26±0.05	2.33±0.33	6.70±0.52	30.20±0.7	36.94±0.33
10^{-5}	1.21±0.03	2.70±0.18	5.80±0.46	24.31±0.7	30.11±0.67
10^{-4}	0.66±0.04	2.37±0.22	4.30±0.37	22.43±0.06	26.73±1.36
10^{-3}	0.56±0.02	1.98±0.07	4.84±0.13	27.08±1.55	27.92±0.06
Fenvalerate					
10^{-6}	1.58±0.08	2.98±0.23	5.51±0.29	31.20±0.09	36.71±1.42
10^{-5}	1.26±0.09	2.40±0.13	4.73±0.16	27.87±0.05	32.60±0.11
10^{-4}	1.26±0.06	2.47±0.17	4.85±0.31	16.53±0.05	21.38±0.42
10^{-3}	1.21±0.03	2.28±0.03	4.29±0.06	17.20±0.44	21.49±0.06

LSD 5% = 0.56; LSD 1% = 0.76

Table 4: Effect of different concentrations of cyanox and fenvalerate on carbohydrate fractions (mg g^{-1} dry weight) of 5 day old *Raphanus sativus* L. cotyledons±SE

Treatment	TMS	Sucrose	Total soluble Sugar	Polysaccharide	Total carbohydrates
Control	15.08±0.48	9.92±0.33	25.00±0.7	114.4±0.23	139.4±2.4
Cyanox					
10^{-6}	87.30±0.15	77.40±0.75	164.70±2.4	85.7±0.76	250.4±0.09
10^{-5}	88.90±0.15	82.20±0.81	171.10±0.33	111.3±0.68	282.4±0.61
10^{-4}	104.70±0.85	101.30±0.52	206.00±2.64	160.1±0.71	366.1±0.65
10^{-3}	101.70±0.94	63.00±0.67	164.70±0.98	135.0±0.73	299.7±1.26
Fenvalerate					
10^{-6}	64.16±0.31	40.84±3.7	105.00±1.7	179.7±2.4	284.7±0.33
10^{-5}	145.5±0.27	87.50±0.57	233.00±1.5	165.0±2.63	398.0±0.71
10^{-4}	123.83±0.71	70.00±0.61	193.83±0.89	156.0±0.68	349.8±0.49
10^{-3}	95.17±0.47	40.83±9.2	136.00±0.57	80.5±1.5	216.5±0.98

LSD 5% = 1.26; LSD 1% = 1.70

Table 4 shows that 10^{-6} M cyanox, though increased total carbohydrate content of the cotyledonary leaves of radish seedlings, yet suppressed polysaccharide accumulation and furthered soluble carbohydrate accumulation particularly sucrose highly significant $p<0.001$. The same level of fenvalerate enhanced better accumulation of carbohydrates than cyanox, basically in the polysaccharide content. The stimulatory effect of

Table 5: Effect of different concentrations of cyanox and fenvalerate on acid and alkaline phosphatase (mg g^{-1} dry weight) of 5 day old *Raphanus sativus* L. cotyledons±SE

Treatment phosphatase	Acid phosphatase	Alkaline
Control	93.43±0.15	19.74±0.31
Cyanox		
10^{-6}	51.10±1.03	21.98±0.15
10^{-5}	66.75±0.39	81.48±0.71
10^{-4}	75.07±0.2	79.74±0.15
10^{-3}	85.84±1.7	71.1±0.48
Fenvalerate		
10^{-6}	77.78±0.27	43.05±0.48
10^{-5}	65.45±0.23	46.58±0.85
10^{-4}	39.22±0.94	69.48±0.47
10^{-3}	25.00±0.81	94.45±0.67

LSD 5% = 0.89; LSD 1% = 1.21

either insecticide on carbohydrate content continued, reaching maximum at 10^{-4} M then declined but still above the control level. Under high levels cyanox was more effective than fenvalerate where is the reverse was the case by low dose application. The relative increase in carbohydrate content was far greater in the soluble than insoluble carbohydrates.

The treated plants carbohydrates progressively increased by both insecticides than control. Under high level cyanox was more effective than fenvalerate where is the reverse was the case by low dose application. Abdullah *et al*. (2006) reported that sugar content in cotton leaves treated with fenvalerate was higher (1.8%) than that of untreated plants (0.75%).

The alkaline phosphatase increased by both insecticides, more prominent by large dose of fenvalerate than control, while the reverse was the case in the acid phosphatase activity (Table 5).

Shakoori *et al*. (1994, 1995) who reported that insecticides belonging to the pyrethroid group inhibit cholinesterase activity and are supposed to have direct effect on acetylcholinesterase activity. Also Bourguet *et al*. (1997) reported concept that organophosphorous insecticide is thought to have only one target site, acetylcholinestrease.

Ravindharn and Xavier (1997) studied the activity of peroxidase (Po) and polyphenol oxidase (PPo) in cotton variety (Mcu 5) the results shows greater in pyrethroid treated leaf samples.

REFERENCES

Abdullah, N.M.M., J. Singh, B.S. Sohal, 2006. Behavioral hormoligosis in oviposition preference of *Bemisa tabaci* on cotton. Pestic. Biochem. Physiol., 84: 10-16.

Bader, K.P. and J. Schuler, 1996. Inhibition of the photosynthetic electron transport by pyrethroid insecticides in cell cultures and thylakoid suspensions from higher plants. Zeitschrift für Naturforschung, C 51: 721-728.

Baloch, A.A., 1989. Insect pests of cotton, their identification, mode of damage and control strategy. Proceedings of Workshop Organized by CWM Project of Sindh in Collaboration with USAID, May 20-25th, 1989, Sakrand, Pakistan, pp: 20.

Bourguet, D., M. Raymond, S. Berrada and D. Fournier, 1997. Interaction between acetylcholine esterase and cholineacetyl transferase: An hypothesis to explain unusual toxicological responses. Resistance'97. integrated approach to combating resistance. Pest. Sci., 51: 276-282.

Das, A.C. and D. Mukherjee, 1994. Effect of insecticides on the availability of nutrients, nitrogen fixation and phosphate solubility in the rhizosphere soil of rice. Biol. Fertile. Soils, 18: 37-41.

Diril, N., S. Sumer and A. Lzbirak, 1990. A survey on mutagenic effects of some organophosphorous insecticides in the *Salmonella microsome* test system. Doga Muhendisilik Ceve Bilimleri, 14: 272-279.

Dzwonkowska, A., H. Nubner and E. Zajac, 1991. The influence of Trichlorfon on organophosphorous insecticide on SCE and dynamics of *in vitro* human lymphocyte divisions. Genetics, 32: 185-188.

Khurana, S., A.D. Khurana and A.N. Verma, 1994. Efficacy of synthetic pyrethroids and conventional insecticides in controlling pink bollworm and their effect on plant phenology, yield and quality of seed cotton. Ind. J. Entomol., 56: 28-35.

Kumar, J., S.D. Sharma and R.S. Jamwal, 1999. Estimation of avoidable yield loss due to fruit borer, *Helicoverpa armigera* (Hubner) in tomato planted at different dates in lower Kullu valley, Himachal Pradesh. Pest. Manage. Econ. Zool., 7: 155-159.

Metzner, H., H. Rau and H. Senger, 1965. Untersuchungen zur synchronisierbarkeit einzelner pigmentangel Mutanten von *Chlorella*. Planta (Berlin), 65: 186.

Naguib, M.I., 1964. Effect of sevin on the carbohydrate and nitrogen metabolism during germination of cotton seeds. Ind. J. Exp. Biol., 2: 149.

Naguib, M.I., 1969. On the colourimetry of nitrogen components of plant tissue. Bull. Fac. Sci., Cairo Univ., 43: 1-5.

O'Brien, R.D., 1967. Insecticides, Action and Metabolism. Academic press, New York.

Ravindharn, R. and A. Xavier, 1997. Effect of pyrethroids on resurgence of aphids (*Aphis gossypii* G.) and alteration of plant metabolism in cotton. Pest. Res. J., 9: 79-85.

Salama, A.Z., E.H.A. Hussein, A.A.M. Awad, A.A. Selim, M.T.I. Fahmy, H.A. Dehondt and S. Kassam, 1991. The mutagenicity of organophosphorous cps in *Drossphila* and *Allium*: Induction of sex-linked recessive leathals and mitotic aberrations. Egypt. J. Anat., 14: 81-92.

Shakoori, A.R., G. Yasmin, M. Ahmed and A.R. Shakoori, 1994. Effect of sumicidin super on blood serum proteins and acetylcholine esterase activity of broiler chicks of *Gallus domesticus*. Proc. Pak. Cong. Zool., Zoological Society of Pakistan, Government College, Lahore, pp: 73-79.

Shakoori, A.R., F. Khalique and M.A. Saleem, 1995. Effect of a synthetic pyrethroid, Ripcord 10EC on esterases of *Tribolium castaneum* (Herbst.). Pak. J. Zool., 27: 165-174.

Viji, C.P. and R.M. Bhagat, 2001. Bioefficacy of some plant products, synthetic insecticides and entomopathogenic fungi against black cutworm, *Agrotis ipsilon* larvae on maize. Ind. J. Entomol., 63: 26-32.