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By

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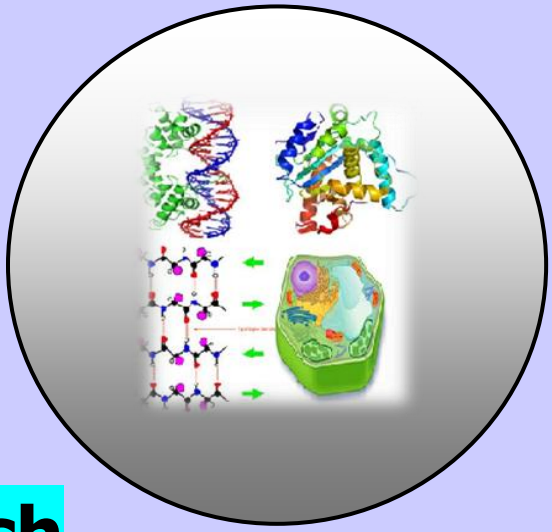

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RESEARCH PAPER
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Comparative effects of Biopestcide (Neem) and Chemical Pesticide (cypermethrin) on Certain Metabolic Parameters in Mustard (*Brassica campestris* L.) Plants

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ABSTRACT

Plants of mustard were subjected to different doses of both biopesticide (neem) and chemical pesticide (cypermethrin) in order to study their comparative effects in the said plant. Higher concentrations of both the pesticides caused decrease in photosynthetic pigments viz. chlorophyll, carotenoids, activity of enzyme catalase and also the contents of sugar and protein in the leaves of mustard plants. Some decreasing trend was found in the activity of enzyme peroxidase at higher concentrations of chemical pesticide. However an enhancement in peroxidase activity was found at higher concentrations of biopesticide.
Key words: Chemical pesticide (cypermethrin), Biopesticide (neem), Chlorophyll, Catalase, Peroxidase, Sugar, Protein and Mustard.

INTRODUCTION

Toxic effects of chemicals in general and chemical pesticides in particular are now well known. Yields of crop plants are adversely affected by the attack of various pests which has to be effectively tackled in order to get better crop yield.

Thus to get rid of pests, use of pesticide is almost necessary. Since chemical pesticides have adverse side effects, an alternative to chemical pesticide is quite in use now a day in the form of biopesticides. Neem oil is supposed to be an effective biopesticide with much lesser adverse effects as compared to chemical pesticide. In the light of above, this study was carried out to compare the effects of both chemical and biopesticide on certain important metabolic parameters in mustard plants.

MATERIAL AND METHODS

This study was carried out to find the comparative effects of different doses of Chemical pesticide (Cypermethrin) and biopesticide (neem oil) on certain important parameters in mustard (Brassica campestris) plants.

Plants were grown in earthern pots in replicates. Pots were labeled and filled with virgin soil collected from a patch of land on Sitapur road Lucknow and arranged in random manners.

Four doses viz. 0.2%, 0.4%, 0.8% and 1.6% of respective chemical and biopesticide along with control were supplied. After seedling attained four to six leaved stage, thinning was done and after one week of thinning, plants were supplied treatments of chemical and biopesticide by foliar spray on aerial parts of mustard test plants.

The first schedule of spray was done at active vegetative growth stage, second at onset of flowering stage and third at fruiting stage. The plant samples were collected seven days after last foliar spray of pesticides.

For analytical purpose, glass distilled water was used. Acid washed glass wares were washed with running tap water and finally with glass distilled water. After wash, they were kept in oven for drying before use.

Biochemical parameters were measured in fresh leaf extract prepared in glass distilled water. 1g. of leaf tissue was extracted in 10 ml of G.D.W. The tissue extract was filtered through a double fold muslin cloth and kept at 2^0 to 4^0 C in refrigerator till various analyses.

Chlorophyll concentrations were determined by the method of Arnon (1949). Enzymes catalase and peroxidase were assayed by the modified methods of Bisht (1972) and Luck (1963) respectively. Concentrations of total sugars and protein were estimated by the methods of Dubias et al (1956) and Lowry et al (1951) respectively.

RESULTS

In the leaves of test plants, photosynthetic pigment viz. chlorophyll ‘a’ was found to be significantly decreased at increasing doses of biopesticide and chemical pesticide as compared to control. The maximum decrease was observed at highest concentration of both pesticides (Table 1).

Chlorophyll ‘b’ content was not significantly increased on increasing the concentrion of biopesticide while on application of chemical pesticide, the same was found to be significantly decreased (Table 1).

Total chlorophyll was decreased at increasing doses of both pesticides. Higher concentrations of these pesticides cause reduction in carotenoid contents also (Table 1).

Biopesticide at initial doses caused significant increase in the activity of enzyme catalase but beyond these doses the activity of same enzyme was found to be reduced. However increasing doses of chemical pesticide caused reduction in the activity of this enzyme. (Table 2).

Peroxidase activity was found to be increased at increasing concentrations of biopesticide while chemical pesticide caused a gradual decrease in the activity of same enzyme except at initial dose of 0.2%, where it showed a slight increase as compared to control (Table 2).

Table 1. Effect of biopesticide (neem oil) and chemical pesticide (cypermethrin) on photosynthetic pigments (i.e, chlorophyll 'a', chlorophyll 'b' and total chlorophyll) and carotenoid contents in mustard (*Brassica campestris* L.) plants.

Parameters	Treatments	Biopesticide	Chemical Pesticide
Chl 'a'content (mg/g FW)	Control	0.895 ± 0.140	0.895 ± 0.140
	0.20%	0.873 ± 0.003	0.762 ± 0.003
	0.40%	0.855 ± 0.006	0.738 ± 0.027
	0.80%	0.813 ± 0.014	0.700 ± 0.001
	1.60%	0.793 ± 0.009	0.623 ± 0.01
	$LSD_{\alpha=0.05}$	0.0259	0.0412
Chl 'b'content (mg/g FW)	Control	0.587 ± 0.007	0.587 ± 0.007
	0.20%	0.590 ± 0.002	0.487 ± 0.007
	0.40%	0.595 ± 0.012	0.471 ± 0.006
	0.80%	0.609 ± 0.008	0.452 ± 0.003
	1.60%	0.595 ± 0.005	0.392 ± 0.007
	$LSD_{\alpha=0.05}$	N.S	0.0195
Total chlorophyll Content (mg/g FW)	Control	1.482 ± 0.003	1.482 ± 0.003
	0.20%	1.463 ± 0.001	1.249 ± 0.004
	0.40%	1.45 ± 0.0180	1.209 ± 0.0210
	0.80%	1.422 ± 0.022	1.152 ± 0.0250
	1.60%	1.388 ± 0.004	1.015 ± 0.0170
	$LSD_{\alpha=0.05}$	0.0407	0.0523
Carotenoids (mg/g FW)	Control	0.783 ± 0.005	0.783 ± 0.005
	0.20%	0.771 ± 0.0140	0.767 ± 0.0210
	0.40%	0.762 ± 0.0130	0.739 ± 0.0260
	0.80%	0.740± 0.008	0.702 ± 0.0220
	1.60%	0.719 ± 0.0270	0.610 ± 0.0110
	$LSD_{\alpha=0.05}$	N.S	0.0589

Table 2. Effect of biopesticide (neem oil) and chemical pesticide (cypermethrin) on enzyme activities [i.e., catalase (CAT) and peroxidase (POD)], in the leaf of mustard (*Brassica campestris* L.*)* plants.

Parameters	Treatments	Biopesticide	Chemical Pesticide
Catalase (µ mole H_2O_2 split /100 mg FW)	Control	725 ± 15	725 ± 15
	0.20%	920 ± 20	630 ± 10
	0.40%	885 ± 25	600 ± 30
	0.80%	785 ± 25	575 ± 15
	1.60%	680 ± 20	470 ± 10
	$LSD_{\alpha=0.05}$	75.612	55.480
Peroxidase (▲OD/100 mg FW)	Control	86.7 ± 0.500	86.7 ± 0.500
	0.20%	87.20 ± 0.400	89.2 ± 0.600
	0.40%	87.8 ± 0.100	84.4 ± 0.200
	0.80%	88.1 ± 0.850	81.8 ± 0.200
	1.60%	100.1 ± 0.100	75.3 ± 0.100
	$LSD_{\alpha=0.05}$	1.513	1.179

Both protein and sugar contents in the leaves of mustard plants were found to be increased at 0.2% and 0.4% concentrations of biopesticide except in sugar content at 0.4% of biopesticide where it showed a decrease as compared to control. However, higher doses of biopesticides i.e, 0.8% and 1.6% caused reduction as compared to control in both protein and sugar contents (Table 3). Higher concentrations of chemical pesticide caused reduced contents of both protein and sugar.

Table 3. Effect of biopesticide (neem oil) and chemical pesticide (cypermethrin) on protein and sugar contents in the leaf of mustard (*Brassica campestris* L.) plants.

Parameters	Treatments	Biopesticide	Chemical pesticide
Protein content (mg/g FW)	Control	13.62498 ± 0.988	13.62498 ± 0.988
	0.20%	15.0112 ± 1.441	13.9 ± 1.00
	0.40%	14.1794 ± 0.792	13.2091 ± 0.386
	0.80%	6.2166 ± 0.230	7.3 ± 1.00
	1.60%	2.8557 ± 0.0682	5.0222 ± 0.285
	LSD $_{\alpha=0.05}$	2.724	2.523
Sugar content (mg/g FW)	Control	0.478 ± 0.00525	0.478 ± 0.00525
	0.20%	0.683 ± 0.00350	0.422 ± 0.0110
	0.40%	0.281 ± 0.00280	0.297 ± 0.0140
	0.80%	0.189 ± 0.00	0.164 ± 0.00700
	1.60%	0.217 ± 0.00350	0.138 ± 0.0130
	LSD $_{\alpha=0.05}$	0.0109	0.0334

DISCUSSION

Although both chemical and biopesticides had adverse effects at their increasing doses on chlorophyll contents but biopesticide had much less adverse effects.

This suggests that biopesticide may be considered to be a better alternative to chemical pesticide. In barley, chlorophyll reduction caused by clomazone application was reported by Kana et.al. (2004).

Such reduction of chlorophyll might be a cause of oxidative chlorophyll degradation which could have resulted into destruction of photosynthetic membrane by reactive oxygen species (ROS) generated from functionally active photosynthetic electron transport (Boger, 1996, Kim et.al, 2001, 2004). Reduced chlorophyll content at increasing doses of pesticide might be due to the reduced translocation of chlorophyll from one place to another. This finding was already given earlier by Johri (2009).

Carotenoid content like chlorophyll also had adverse effects at increasing doses of both chemical and biopesticides. Johri et al (2011) had also reported such adverse effect of both pesticides on carotenoid content.

Activities of two iron enzymes i.e., catalase and peroxidase had differential response to the exposure of both the pesticides.

In case of biopesticide application, this differential response in the activities of these two enzymes might be due to the working of scavenging mechanism against stress condition while chemical pesticide might have caused oxidative damage against stress condition (Johri, 2009, Johri. et.al, 2011). It is quite clear from this study that chemical pesticide is more toxic to plants as compared to biopesticide and thus use of biopesticide may be preferentially recommended.

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REFERENCES

Arnon, D.I. (1949). Copper enzymes in isolated chloroplasts. Polypenoloxidase in *Beta vulgaris*. *Plant Physiology*. 24:1-15.

Bisht, S.S. (1972). Effect of heavy metals on plant metabolism. Ph.D. Thesis. University of Lucknow, Lucknow, India.

Boger, P. (1996). Mode of action of herbicides affecting Cartenogenesis. J.Pestic. Sci 21:473.

Dubias, M.K.A., Hamilton, J.K., Rebos, P.A and Smith, F. (1956). Colorimetric method of determination of sugar and related substances. *Annals of chemistry*. 28: 350-356.

Johri Tulika (2009). Comparative studies of chemical and biological pesticides on some selected plants. Ph.D. Thesis. University of Lucknow, Lucknow, India.

Johri Tulika, Akash Vikram and P.K.Tandon (2011). Effect of cypermethrin and neem oil on the physiological parameters of *Spinacia oleracea*: A comparative study. *Res. Environ. Life Sci* 4(2) 89- 92.

Kana, R., Spundova, M., Ilik, P., Lazar, D., Klem, K., Tomek, P., Naus, J. and Prasil, O. (2004). *Pesticide Biochemistry and Physiology* 78: 161 – 170.

Kim, J.S. Kim, T.J, Kwon, O.K. and Cho, K.Y. (2001). Mechanism of action of sulcotrione in developed plant tissue. B CPC- weeds 2:557.

Kim, J.S., Yun, B.W., Choi, J.S., Kim, T.J., Kwook, S.L. and Chio, K.Y. (2004). Death mechanism caused by carotenoid biosynthesis inhibitors in green and in undeveloped tissue. *Pesticide biochemistry and physiology* 78:127-139.

Lowry, O.H., Rosenbrough, N.J., Farr, A.L. and Randall, R.J. (1951). Protein measurement with folin reagent. *J.Biol. Chem* 193:265- 275.

Luck, H. (1963). Peroxidase: Methods of enzymatic analysis (Ed. Bergmayer) p 895-897.

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