



Response of *Vigna sinensis* on application of different concentrations of biopesticide and chemical pesticide

Abstract

The effect of both bio-pesticide (Neem oil) and chemical pesticide (cypermethrin) in different concentrations viz. 0.2%, 0.4%, 0.8% and 1.6% were investigated on cowpea plants. It was observed that on increasing the concentration of both bio-pesticide and chemical pesticide upto 0.4% plant height was found to be increased. However, this increase upto same concentration in case of chemical pesticide was non-significant. At increasing doses of both bio and chemical pesticides, number of leaves per plant, fresh weight and dry weight per plant were significantly decreased. The same trend was observed in the biomass yield of the crop. The water content per plant increased at 0.2% concentration of both bio and chemical pesticides but further it was decreased on increasing the concentration of both pesticides. However, such decrease was higher in plants treated with chemical pesticide as compared to biopesticide. With regard to metabolic parameters, concentration of photosynthetic pigment in general was found to be decreased at higher concentration of both bio and chemical pesticides. Activity of enzyme catalase was found to be significantly increased at 0.2% and 0.4% of both bio and chemical pesticides. However the enzyme peroxidase was significantly decreased beyond the concentration of 0.4% of bio pesticide and beyond 0.2% of chemical pesticide. Concentration of both protein and sugar were found to be decreased at increasing concentration of both chemical and bio pesticides.

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Introduction

Since the beginning of domestication of crops battle between the mankind and pests began. Earlier huge losses of crops occurred annually due to insect pests. With time pesticides have become an integral part of modern agriculture, which are used to prevent the growth of unwanted living organisms. Biggest challenge of the today's time is to meet up with the increasing food demand of the growing population. To achieve this goal we use chemicals, fertilizers and genetically modified seeds to increase the crop production and productivity, and the pesticides to reduce the attack of pest. What becomes bad or worse is the overdose and indiscriminate use of pesticides by the farmers. This causes many problems and pollution of air, soil and water. When used in a non-selective and unsystematic manner it (pesticides) may lead to residues in food, feed and fodder, which may act as a potential hazard to human beings and other animals. The uncontrolled doses of foliar spray affect the overall growth of the plant. The present research work deals with many faces of chemical pesticides and bio-pesticide discussing various impacts on plant morphology and physiology.

Without pesticide we could lose huge amount of global crop each year. Insufficient food production will result in mass starvation.

Use of pesticides give an assurance to farmers in protecting their investments in seeds, fertilizers, irrigation and their own hard labour, from insects and pests. Hence, pesticides are indispensable in modern agriculture.

Materials and Methods

Experiments were carried out to study the comparative effects of different doses of Neem oil (bio-pesticide) and Cypermethrin (chemical pesticide) on the metabolism of Cowpea (*Vigna sinensis*). Plants were raised from the seeds of Cowpea (*Vigna sinensis*) family- Leguminosae. The deionized water was used for irrigating plants. For analytical purpose, glass distilled water (G.D.W.) was used. The glasswares used for the analytical work, were routinely Acid washed and dried in oven. For experiments, virgin soil was collected from a patch of agricultural land on Sitapur Road. About ten kilograms of fertilizer mixed soil was filled in each earthen pot. Earthen pots containing virgin soil were made wet with deionised water. The Earthen pots were labelled and arranged in random manner on the wooden benches, placed in north-south direction in a wire house which was pest free. Four doses having respective concentrations of 0.2, 0.4, 0.8 and 1.6% were used for foliar spray on aerial parts of the plants. Plants were

given foliar spray treatment of different pesticides and their respective concentrations. The group of plants in earthen pots labelled as neem oil 0.2, 0.4, 0.8 and 1.6 were sprayed with neem oil of 0.2, 0.4, 0.8 and 1.6 strength, respectively with the help of hand operating sprayer. In the same manner, chemical pesticide, Cypermethrin was sprayed. a 'U' shaped cardboard was used to separate the currently treated pot with rest of the pots so that the foliar spray may not affect pots in the vicinity. The plant samples were collected carefully, seven days after last foliar spray of pesticides.

Biochemical parameters: The various biochemical parameters except chloroplastic pigments were assayed in crude leaf extracts made in glass-distilled water. Finally chopped de-veined leaf material obtained from young leaf was ground with chilled acid washed silica sand in an ice chilled pestle and mortar kept in an ice bath. One gram of leaf tissue was extracted in 10 ml of glass-distilled water. The tissue extract was filtered through a double fold muslin cloth and kept at 20-40°C in refrigerator till the time of various assays. Chlorophyll concentration was determined by the method of Arnon (1949). Catalase activity was assayed by the modified method of Bisht (1972). Peroxidase was assayed by the modified method of Luck (1963) and carbohydrate was estimated by Dubias et al. (1956).

Morphological parameters: Observations were taken at an interval of seven days after first foliar spray on the following parameters.

a) Height of Plant: Height of ten plants for each treatment including control was measured. Height of each plant from the upper surface of the soil in each pot upto the tip of that particular plant was measured in cms. Mean value of the height for a particular population was calculated. Percent increase/decrease in growth of plant in respect to control was calculated.

b) Number of Leaves: Total number of leaves per plant was counted in replicates. Each replicate consisted of five plants.

c) Number of Flowers: Total number of flowers per plant were counted including control and replicates

d) Number of Fruits: Total number of fruits produced by each plant of control and replicates were counted.

e) Fresh weight, Dry weight and Total Biomass: Plants harvested were taken out of the pots and washed in running tap water. The plant was rinsed properly with tap water and finally was washed with Glass distilled water. The washed plant material was then blotted dry and separated into many parts. These parts were weighed on electronic weighing balance for determining fresh weight.

After taking fresh weight, the material was finally kept in paper bags and dried in oven at 70°C for forty eight hours. The oven dried material was transferred to desiccators and after allowing it to cool to room temperature, it was weighed accurately on an electronic balance. Total Biomass was calculated.

Statistical Analysis: All estimations have been made in replicates and the data were analysed using analysis of variance (ANOVA) and compared for the level of significance by Dunncanns test using Sigma stat software. L.S.D. was calculated by Fisher test.

Results and Discussion

Vegetative growth: The effect of both biopesticide and chemical pesticide of different concentrations *i.e.* 0.2%, 0.4%, 0.8% and 1.6% were studied on cowpea. Results indicated that on increasing the concentration of biopesticide and chemical pesticide up to 0.4%, vegetative growth was found to be significantly increased. By the use of chemical pesticide, same trend was observed where the growth of the plant non-significantly increased at 0.2% and 0.4% concentration. With the increase in the concentration of pesticide, much better vegetative growth was observed with biopesticide as compared to chemical pesticide (Table-1). Number of branches significantly increased on increasing the concentration of both bio and chemical pesticides as compared to control. By the use of chemical pesticide, significant increment was observed upto 0.4% concentration (Table-1).

The number of flowers/ plant was found to be significantly increased, on increasing the concentration of biopesticide and chemical pesticide. There was a significant increase at increasing concentration of both types of pesticides. However, maximum increase was observed at initial concentration (0.2%) in both bio and chemical pesticides. (Table -2). The number of fruits/ plant was found to be increased at 0.2% and 0.4% concentration of biopesticide, while on further increasing the concentration, it decreased. In case of chemical pesticide, it decreased non-significantly on increasing the concentration. (Table-2). Similar trend was observed in case of fruit length (Table-2).

Same trend was found in case of number of seeds/ pod. The number of seeds/ pod, non- significantly increased at 0.2% concentration of biopesticide and chemical pesticides than the control. However it was found to be decreased on increasing the concentration of bio and chemical pesticides. Maximum decrease

Table-1: Effect of bio pesticide (neem oil) and chemical pesticide (cypermethrin) on vegetative growth in cowpea (*Vigna sinensis* L.) plants

| Parameters | Treatments | Biopesticide | Chemical Pesticide |
|-------------------------|---------------------------|--------------|--------------------|
| Plant height (cm) | Control | 176 ± 2 | 176 ± 2 |
| | 0.20% | 229 ± 14 | 198 ± 2 |
| | 0.40% | 186.5 ± 25 | 178 ± 16.5 |
| | 0.80% | 167 ± 3 | 150 ± 1.5 |
| | 1.60% | 142 ± 3 | 134 ± 9 |
| | LSD $\alpha=0.05$ | 40.915 | 26.867 |
| | Number of branches /plant | Control | 6.5 ± 0.500 |
| 0.20% | | 10 ± 1 | 8.5 ± 0.500 |
| 0.40% | | 9 ± 0.00 | 8.0 ± 0.00 |
| 0.80% | | 9.5 ± 0.500 | 7.5 ± 0.500 |
| 1.60% | | 8 ± 1.00 | 7.00 ± 0.00 |
| LSD $\alpha=0.05$ | | 2.228 | 1.220 |
| Number of leaves /plant | | Control | 25.500 ± 0.500 |
| | 0.20% | 29 ± 0.00 | 28 ± 1.00 |
| | 0.40% | 26.5 ± 0.500 | 27 ± 0.00 |
| | 0.80% | 26 ± 0.00 | 25 ± 1.00 |
| | 1.60% | 26 ± 0.00 | 25 ± 1.00 |
| | LSD $\alpha=0.05$ | 0.996 | N. S. |

Table-2: Effect of biopesticide (neem oil) and chemical pesticide (cypermethrin) on reproductive yield in cowpea (*Vigna sinensis* L.) plants

| Parameters | Treatments | Biopesticide | Chemical Pesticide |
|--------------------------------|-------------------|---------------|--------------------|
| Number of flowers/plant | Control | 5.500 ± 0.50 | 5.50 ± 0.50 |
| | 0.20% | 23.00 ± 1.00 | 17.50 ± 0.50 |
| | 0.40% | 17.500 ± 4.50 | 14.00 ± 1.00 |
| | 0.80% | 17.00 ± 1.00 | 12.00 ± 1.00 |
| | 1.60% | 11.00 ± 1.00 | 10.500 ± 0.50 |
| | LSD $\alpha=0.05$ | 2.636 | 2.337 |
| Number of fruits/plant | Control | 26.00 ± 1.00 | 26.00 ± 0.00 |
| | 0.20% | 27.500 ± 0.50 | 26.50 ± 0.50 |
| | 0.40% | 26.500 ± 0.50 | 24.00 ± 2.00 |
| | 0.80% | 25.00 ± 1.00 | 24.50 ± 0.50 |
| | 1.60% | 20.500 ± 0.50 | 23.00 ± 1.00 |
| | LSD $\alpha=0.05$ | 2.337 | N.S. |
| Fruit length(cm) | Control | 18.50 ± 0.50 | 18.50 ± 0.50 |
| | 0.20% | 18.50 ± 0.50 | 17.750 ± 0.75 |
| | 0.40% | 18.50 ± 0.50 | 15.500 ± 0.50 |
| | 0.80% | 16.50 ± 1.00 | 15.500 ± 1.00 |
| | 1.60% | 16.25 ± 0.25 | 14.00 ± 0.00 |
| | LSD $\alpha=0.05$ | 1.453 | 2.024 |

Table-3: Effect of biopesticide (neem oil) and chemical pesticide (cypermethrin) on seed yield and biomass yield in cowpea (*Vigna sinensis* L.) plants

| Parameters | Treatments | Biopesticide | Chemical Pesticide |
|--------------------------------|-------------------|----------------|--------------------|
| Number of seeds /pod | Control | 11.00 ± 1.00 | 11.00 ± 1.00 |
| | 0.20% | 13.500 ± 0.500 | 12.00 ± 0.00 |
| | 0.40% | 11.500 ± 1.500 | 9.500 ± 0.500 |
| | 0.80% | 11.00 ± 1.00 | 7.00 ± 0.00 |
| | 1.60% | 10.00 ± 1.00 | 6.00 ± 0.00 |
| | LSD $\alpha=0.05$ | N.S. | N.S. |
| Weight of 10 seeds(g) | Control | 1.540 ± 0.130 | 1.540 ± 0.130 |
| | 0.20% | 1.313 ± 0.107 | 1.415 ± 0.225 |
| | 0.40% | 1.192 ± 0.0425 | 1.110 ± 0.025 |
| | 0.80% | 1.153 ± 0.222 | 1.070 ± 0.170 |
| | 1.60% | 0.890 ± 0.345 | 0.945 ± 0.275 |
| | LSD $\alpha=0.05$ | N.S. | N.S. |
| Biomass yield (g/plant) | Control | 23.256 ± 1.414 | 23.256 ± 1.414 |
| | 0.20% | 28.648 ± 0.353 | 27.146 ± 1.674 |
| | 0.40% | 26.476 ± 1.436 | 19.791 ± 0.856 |
| | 0.80% | 18.223 ± 0.832 | 17.485 ± 0.515 |
| | 1.60% | 17.491 ± 0.471 | 14.486 ± 0.784 |
| | LSD $\alpha=0.05$ | N.S. | 3.569 |

was observed in case of chemical pesticide as compared to biopesticide (Table-3).

Fresh weight, dry weight, water content and total biomass: Results indicated that fresh weight and dry weight significantly increased at 0.2% concentration of biopesticide and chemical pesticide. While on further increasing the concentration, it significantly decreased as compared to control in both the cases, i.e. biopesticide and chemical pesticide. The same trend was observed in biomass yield of the crop. The water content per plant increased at 0.2%

Table-4: Effect of biopesticide (neem oil) and chemical pesticide (cypermethrin) on fresh weight, dry weight and water content in cowpea (*Vigna sinensis* L.) plants

| Parameters | Treatments | Biopesticide | Chemical Pesticide |
|--------------------------------|-------------------|-----------------|--------------------|
| Fresh weight (g/plant) | Control | 154.82 ± 0.980 | 154.82 ± 0.980 |
| | 0.20% | 181.054 ± 0.909 | 165.583 ± 0.471 |
| | 0.40% | 168.626 ± 2.351 | 145.513 ± 1.058 |
| | 0.80% | 141.42 ± 0.772 | 133.573 ± 1.600 |
| | 1.60% | 128.929 ± 0.596 | 121.530 ± 0.160 |
| | LSD $\alpha=0.05$ | 4.051 | 3.511 |
| Dry weight (g/plant) | Control | 23.256 ± 1.414 | 23.256 ± 1.414 |
| | 0.20% | 28.648 ± 0.353 | 27.146 ± 1.674 |
| | 0.40% | 26.476 ± 1.436 | 19.791 ± 0.856 |
| | 0.80% | 18.223 ± 0.832 | 17.485 ± 0.515 |
| | 1.60% | 17.491 ± 0.471 | 14.486 ± 0.784 |
| | LSD $\alpha=0.05$ | 3.182 | 3.569 |
| Water content (g/plant) | Control | 131.564 ± 1.144 | 131.564 ± 1.144 |
| | 0.20% | 152.406 ± 0.777 | 138.437 ± 0.387 |
| | 0.40% | 142.15 ± 0.218 | 125.722 ± 0.318 |
| | 0.80% | 123.197 ± 0.334 | 116.088 ± 0.110 |
| | 1.60% | 111.438 ± 0.533 | 107.044 ± 0.175 |
| | LSD $\alpha=0.05$ | 2.163 | 1.784 |

Table-5: Effect of biopesticide (neem oil) and chemical pesticide (cypermethrin) on photosynthetic pigments (i.e., chlorophyll 'a', chlorophyll 'b' and total chlorophyll) in cowpea (*Vigna sinensis* L.) plants

| Parameters | Treatments | Biopesticide | Chemical Pesticide |
|------------------------------------|-------------------|----------------|--------------------|
| Chl. 'a' (mg/g FW) | Control | 1.32 ± 0.0700 | 1.32 ± 0.0700 |
| | 0.20% | 1.371 ± 0.187 | 0.977 ± 0.0030 |
| | 0.40% | 1.198 ± 0.0520 | 0.848 ± 0.004 |
| | 0.80% | 0.872 ± 0.0990 | 0.398 ± 0.004 |
| | 1.60% | 0.847 ± 0.0175 | 0.385 ± 0.002 |
| | LSD $\alpha=0.05$ | 0.325 | 0.0991 |
| Chl. 'b' (mg/g FW) | Control | 0.624 ± 0.0150 | 0.624 ± 0.0150 |
| | 0.20% | 0.606 ± 0.0130 | 0.367 ± 0.0190 |
| | 0.40% | 0.591 ± 0.0170 | 0.346 ± 0.0240 |
| | 0.80% | 0.274 ± 0.0210 | 0.340 ± 0.0090 |
| | 1.60% | 0.233 ± 0.0210 | 0.184 ± 0.0170 |
| | LSD $\alpha=0.05$ | 0.0557 | 0.0552 |
| Total chlorophyll (mg/g FW) | Control | 1.944 ± 0.0850 | 1.944 ± 0.0850 |
| | 0.20% | 1.977 ± 0.200 | 1.344 ± 0.0150 |
| | 0.40% | 1.789 ± 0.0690 | 1.194 ± 0.0280 |
| | 0.80% | 1.146 ± 0.0780 | 0.738 ± 0.0130 |
| | 1.60% | 1.08 ± 0.00350 | 0.569 ± 0.0130 |
| | LSD $\alpha=0.05$ | 0.340 | 0.130 |

concentration and further it decreased on increasing the concentration of biopesticide and chemical pesticide. Decrease was higher in plants treated with chemical pesticide as compared to biopesticide (Table-3, 4).

Photosynthetic pigments: Different concentrations of biopesticide and chemical pesticide were studied on photosynthetic pigments like chlorophyll 'a', chlorophyll 'b' and carotenoids. Results indicated that chlorophyll significantly decreased at higher concentrations of biopesticide (Table-5).

Table-6: Effect of biopesticide (neem oil) and chemical pesticide (cypermethrin) on photosynthetic pigments (i.e, carotenoids) and carotenoid: chlorophyll ratio in cowpea (*Vigna sinensis* L.) plants

| Parameters | Treatments | Biopesticide | Chemical Pesticide |
|--------------------------------------|-----------------------|----------------|--------------------|
| Carotenoids (mg/g FW) | Control | 0.735 ± 0.0160 | 0.735 ± 0.0160 |
| | 0.20% | 0.741 ± 0.0150 | 0.739 ± 0.0180 |
| | 0.40% | 0.649 ± 0.0270 | 0.627 ± 0.0300 |
| | 0.80% | 0.385 ± 0.0310 | 0.336 ± 0.0130 |
| | 1.60% | 0.314 ± 0.0210 | 0.254 ± 0.0180 |
| | LSD _{α=0.05} | 0.0720 | 0.0626 |
| Carotenoid: chlorophyll ratio | Control | 0.378 ± 0.0260 | 0.378 ± 0.0260 |
| | 0.20% | 0.374 ± 0.0060 | 0.549 ± 0.0080 |
| | 0.40% | 0.362 ± 0.0100 | 0.525 ± 0.0090 |
| | 0.80% | 0.335 ± 0.0200 | 0.455 ± 0.0320 |
| | 1.60% | 0.290 ± 0.0170 | 0.446 ± 0.0080 |
| | LSD _{α=0.05} | 0.0546 | 0.0616 |

Table-7: Effect of biopesticide (neem oil) and chemical pesticide (cypermethrin) on enzyme activities [i.e., catalase (CAT) and peroxidase (POD)] in the leaf of cowpea (*Vigna sinensis* L.) plants

| Parameters | Treatments | Biopesticide | Chemical Pesticide |
|--|-----------------------|---------------|--------------------|
| Catalase (µ mole H₂O₂ split /100 mg FW) | Control | 280 ± 0.00 | 280 ± 0.00 |
| | 0.20% | 940 ± 0.00 | 970 ± 1.00 |
| | 0.40% | 640 ± 20 | 870 ± 10 |
| | 0.80% | 137 ± 3 | 221 ± 1.00 |
| | 1.60% | 137.8 ± 2.2 | 202 ± 2.00 |
| | LSD _{α=0.05} | 28.667 | 14.509 |
| Peroxidase (%OD/100 mg FW) | Control | 48.4 ± 1.400 | 48.4 ± 1.400 |
| | 0.20% | 56.95 ± 1.150 | 55.90 ± 0.628 |
| | 0.40% | 49.4 ± 0.600 | 44.8 ± 0.700 |
| | 0.80% | 39.00 ± 0.727 | 38.7 ± 1.700 |
| | 1.60% | 35.9 ± 0.777 | 38.6 ± 0.977 |
| | LSD _{α=0.05} | 3.079 | 3.645 |

Table-8: Effect of biopesticide (neem oil) and chemical pesticide (cypermethrin) on protein and sugar content in the leaf of cowpea (*Vigna sinensis* L.) plants

| Parameters | Treatments | Biopesticide | Chemical Pesticide |
|----------------------------------|-----------------------|-----------------|--------------------|
| Protein content (mg/g FW) | Control | 37.607 ± 0.287 | 37.607 ± 0.287 |
| | 0.20% | 48.063 ± 0.574 | 37.052 ± 0.376 |
| | 0.40% | 47.508 ± 0.0695 | 36.399 ± 0.307 |
| | 0.80% | 39.091 ± 0.398 | 35.012 ± 0.120 |
| | 1.60% | 37.632 ± 0.022 | 32.267 ± 0.142 |
| | LSD _{α=0.05} | 1.069 | 0.837 |
| Sugar contents (mg/g FW) | Control | 1.477 ± 0.0230 | 1.477 ± 0.0230 |
| | 0.20% | 1.212 ± 0.0320 | 1.461 ± 0.00900 |
| | 0.40% | 1.041 ± 0.00300 | 1.393 ± 0.00100 |
| | 0.80% | 1.058 ± 0.00100 | 1.33 ± 0.0500 |
| | 1.60% | 0.98 ± 0.00800 | 1.31 ± 0.169 |
| | LSD _{α=0.05} | 0.0568. | N.S. |

An initial non-significant stimulation was observed in chlorophyll 'a' at 0.2% concentration of biopesticide. Application of chemical pesticide caused reduction in this parameter. Chlorophyll

'b' also significantly decreased on increasing the concentrations of biopesticide and chemical pesticide. Maximum decrease was observed on increasing the application of chemical pesticide. The same trend was observed in total chlorophyll.

The carotenoid content was significantly increased at lower dose i.e., at 0.2%, while on increasing the concentration it decreased significantly in both, bio and chemical pesticides (Table-6). On application of biopesticide carotenoid and chlorophyll ratio was found to be decreased significantly. While on application of chemical pesticide there was significant increase at 0.2% concentration, on further increase in concentration, carotenoid and chlorophyll ratio decreased significantly (Table-6).

Metabolic activities:

Effect of activities of anti-oxidative enzymes viz. catalase (CAT) and peroxidase (POD): Results showed that activity of antioxidative enzyme, catalase was significantly increased at 0.2% and 0.4% concentrations of biopesticide and chemical pesticide (Table-7). However activity of peroxidase (POD) was significantly decreased beyond the concentration 0.4% of biopesticide and beyond 0.2% of chemical pesticide (Table-7).

Protein and sugar content: Results showed that Protein content was significantly increased at increasing concentration of biopesticide (Table-8). However, it was found to be decreased at increasing concentration of chemical pesticide. Sugar content was significantly decreased on increasing the concentration of biopesticide than the control while it was non-significantly decreased in case of chemical pesticide.

Pesticides are inevitable. To increase the production of crop, we need to apply or use them. But the non-selective use of pesticide leads to many potential risk to human beings and other animals. In this study overdose of neem oil and cypermethrin was studied in terms of vegetative growth, yield, water content, photosynthetic pigments and some metabolic activities of cowpea plant. Suppression of growth due to action of chemical pesticide might have resulted from the toxic effects of cypermethrin pesticide on certain enzymes and growth hormones in mustard subjected to different doses of the pesticide. Biopesticide i.e, neem oil proved to have mild action rather harmless adverse action on test plants. Yadava et al., (1997) reported similar results on some plants.

The increase in fresh weight might be due to more uptake of water in plant parts, and on further increasing the concentration Chemical pesticide i.e, cypermethrin caused adverse effects on the concentration of chlorophyll at its increasing doses. Chlorophyll content in leaves decreased with increasing concentrations of biopesticide. Chlorophyll 'a' decreases on increasing the concentration of biopesticide in mustard. However chlorophyll 'b' was non-significantly decreased. Increasing the concentration of chemical pesticide caused decrease in total chlorophyll. Reduction of chlorophyll due to clomazone in barley was reported by Kana (2004). Fayeze (2000) reported such type of toxic action of herbicide on chlorophyll content of Soyabean plants. Reduction in chlorophyll content was probably due to oxidative degradation of chlorophyll and rapid destruction of photosynthetic membrane by reactive oxygen species (ROS) generated from functionally active

photosynthetic electron transport (Boger 1996, Kim *et al.*, 2001, 2004). Reduction of chlorophyll content might be due to reduced translocation from one place to another due to excess amount of pesticides. Carotenoid content was decreased on increasing the concentration of biological pesticide. On application of chemical pesticide, it was found to be increased on increasing the concentrations upto 0.8%, while at 1.6% concentration of chemical pesticide, it was decreased. Carotenoid/ chlorophyll ratio was found to be enhanced on application of both neem oil and cypermethrin. This might be due to the prevention of oxidative stress of test plants due to their own defense mechanism. Some anti-oxidative enzymes *i.e.*, catalase and peroxidase were also affected due to heavy doses of chemical pesticide. In cowpea, the catalase activity was significantly increased at initial dose of biopesticide while peroxidase was decreased. In case of cypermethrin, both catalase and peroxidase was adversely affected. The increased catalase activity and decreased peroxidase activity showed scavenging mechanism against stress condition while in case of chemical pesticide it showed oxidative damage against stress condition. Chowdhury *et al.* (2002) found chemical pesticide to be more phytotoxic than neem seed kernel concentrate on soyabean and maize. He also found increased activity of peroxidase enzyme in treated plants. Stimulation of enzyme activity due to cypermethrin might have resulted from oxidative stress producing compound *i.e.*, H₂O₂ and free radicles. An increase in peroxidase activity at high concentration of some pesticide was also observed by Srivastava *et al.* (1972). While on application of cypermethrin, sugar content was decreased on increasing the concentration of this chemical pesticide in all plants. Balayannis (1983) had observed increase in concentration of water-soluble sugar in the leaves of tobacco plants and decrease in crude protein content. Protein content was increased at 0.2%, 0.4% and 0.8% concentrations of biopesticide in mustard, but it was found to decreased at 1.6% concentrations. Application of chemical pesticide on cowpea showed decreased protein content at its increasing doses.

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