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Effect of 2, 4-D on the Growth and Biochemical Characteristics of *Abelmoschus esculentus* (L.) Moench

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Abstract: Herbicides used to clear waste ground, industrial sites, railways and railway embarkments are non-selective and kill all plant material. But herbicides used in agricultural land are selective and kill only the weeds. Certain herbicides affect metabolic pathways and systems unique to plants but absent in animals. Many modern herbicides are the safest crop protection products having essentially no effect on mammals, birds, amphibians and reptiles. Herbicides applied to the soil are taken up by the roots and hypocotyls of the target plants. 2,4-Dichlorophenoxy acetic acid (2,4-D) a chlorinated phenoxy compound, functions as a systemic herbicide and is used to control many types of broad leaf weeds. The 2,4-D treated Bhendi seedlings have shown a reduction in the fresh weight, dry weight, root length, shoot length. Biochemical constituents such as protein, glucose, proline was also decreased. The activity of enzyme peroxidise was found to be increased. Catalase was found to be decreased in the treated seedlings of Bhendi. Chlorophyll reduction, protein reduction and glucose decline are some of the serious changes that ultimately caused the growth retardation of the Bhendi plant.

Key words: Herbicide · 2,4-D · Proline · Catalase · *Abelmoschus esculentus* (L.) Moench

INTRODUCTION

Herbicides are the most widely used class of pesticides. They are effective and economical in controlling weeds and because weeds are the most important pest in crop production. In addition, herbicides reduce manpower and horsepower requirements and erosion-producing tillage in crop production. Certain herbicides affect metabolic pathways and systems unique to plants and absent in animals making many modern herbicides the safest crop protection products having essentially no effect on mammals, birds, amphibians or reptiles. Almost all herbicides, in use today, are considered “organic” herbicides in that they contain carbon as a primary molecular component. Organic herbicides are expensive and may not be affordable for commercial production. They have much less effect than the synthetic herbicides and are generally used along with cultural and mechanical weed control pesticides.

2,4-Dichlorophenoxy Acetic acid (2,4-D), a chlorinated phenoxy compound, functions as a systemic herbicide and is used to control many types of broad leaf weeds. There are many forms of derivatives (esters, amines, salts) of 2,4-D and these vary in solubility and volatility. This compound is used in cultivated agriculture and in pasture and rangeland applications, forest management, home and garden situations and for the control of aquatic vegetation. 2,4-D was a major component (about 50%) of the product Agent Orange used extensively throughout Vietnam, during US – Vietnam War [1].

Abelmoschusesculentus, (L.) Moench is one of the common vegetable. It belongs to the family Malvaceae. It is cultivated throughout the tropical and warm temperate regions of the world for its fibrous fruits or pods containing round white seeds. The fruits are harvested when immature and eaten as a vegetable.

2,4-D is a common herbicide used in the fields to remove the weeds. The present study is conceived to analyse the impact of 2,4-D on a vegetable crop like Abelmoschusesculentus.

MATERIALS AND METHODS

The seeds and herbicides were obtained from Agnar efforts, Srivilliputhur, Tamil Nadu, India. Various

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concentration of 2,4-D (1ppm, 2ppm, 3ppm, 4ppm and 5ppm) were prepared. Both control and experimental plants were grown in the pot containing mixture of red soil, black soil and sand in the ratio of 2:2:1. After 10 days of growth, the seedlings were treated with various concentration of 2,4-D. After 5 days of treatment, various morphometric, biochemical and enzyme characteristics were analysed. The morphometric characters such as root length, shoot length, fresh weight and dry weight were measured using meter scale and weighing balance. The biochemical and enzymatic characters were analyzed by the following methods: Chlorophyll and carotenoids, Protein, total soluble sugar, proline, *in vitro* nitrate reductase activity, catalase, peroxidise [2].

RESULTS AND DISCUSSION

In the present analysis growth characters like shoot length, root length, fresh weight, dry weight are found to be decreased (Table 1; Figure 1) which is in conformation to the previous works done by and the 2,4-D treated seedlings have shown a reduction in the fresh weight and dry weight. This is in consonance with the earlier reports of [3-12]. Chlorophyll was found to be decreased considerably (Table 2; Figure 2). This will supported by. Reduction in the chlorophyll content is probably due to the inhibition of chlorophyll biosynthetic pathway by the insecticide 2,4-D. Glucose, protein were also reduced considerably in those plants which are treated with 2,4-D than the control (Table 2; Figure 2) this is probably due to the inhibition of photosynthetic machinery especially the Hill reaction. This has already been supported by. The reduction in sugar content may be attributed to reduction in chlorophyll content of the leaf and also a decline in protein. This change might have already affected the photosynthetic activity of the plant and hencereduction in contents.Proline. a universal stress indicator, is also found to be accumulated considerably in the treated plants of Bhendi. This already supported by [13]. Peroxidise is the enzyme responsible for scavenging the free radicals accumulated in the stressed plants. Peroxidise is found to be increased considerably which is certainly due to the accumulation of oxygen free radicals. Catalase is found to be decreased in the treated seedlings of Bhendi (Table 3 & Figure 3). In general, 2,4-D has caused overall inhibition of growth reduction in vital parameters of the Bhendi (*Abelmoschusesculentus*) (L.) Moench [14].

Table 1: Effect of 2,4-D on growth characters of 10 day old seedlings of *Abelmoschus esculentus*(L.) Moench

S.No.	Parameters	Control	1 ppm	2 ppm	3ppm	4ppm	5ppm
1.	Root length (cm)	8.63±0.035 (100)	8.23±0.052 (95)	7.76±0.061(89)	7.06±0.056 (81)	4.56±0.10 (52)	3.80±0.04 (44)
2.	Shoot length (cm)	17.06±0.46 (100)	16.90±0.52 (99)	16.00±0.32 (93)	15.83±0.24 (92)	14.43±0.37 (84)	12.43±0.19 (72)
3.	Fresh weight (gm)	1.76±0.002 (100)	1.58±0.16 (89)	1.47±0.092 (83)	1.25±0.071 (71)	1.21±0.017 (68)	1.15±0.032 (65)
4.	Dry weight (gm)	0.250±0.016 (100)	0.205±0.035 (82)	0.196±0.087 (78)	0.193±0.016 (77)	0.182±0.003 (72)	0.160±0.007 (64)
5.	Leaf area (cm^2)	8.0±0.004 (100)	7.5±0.014 (93)	7.0±0.007 (87)	6.8±0.061 (85)	6.5±0.008 (81)	6.0± 0.11 (75)

Table 2: Effect of 2,4-D on photosynthetic pigments and biochemical characteristics of 10 day old seedlings of *Abelmoschus esculentus*(L.) Moench

S.No	Parameters	Control	1 ppm	2 ppm	3ppm	4ppm	5ppm
1.	Total chlorophyll (mg/gLFW)	3.24 ± 0.014 (100)	2.61 ± 0.20 (80)	2.41 ± 0.051 (74)	2.02 ± 0.031 (62)	1.98 ±0.016 (61)	1.82 ±0.031 (56)
2.	Carotenoids (mg/gLFW)	1.217 ±0.006 (100)	1.447 ±0.009 (119)	1.640 ±0.008 (135)	1.650 ±0.002 (136)	1.670 ±0.004 (138)	1.760 ±0.002 (145)
3.	Total soluble protein (mg/gLFW)	27.73 ± 0.014 (100)	27.20 ± 0.041 (98)	26.66 ± 0.009 (96)	25.06 ± 0.008 (90)	20.80 ± 0.004 (75)	18.13 ± 0.017 (65)
4.	Total soluble sugar (mg/gLFW)	5.90 ± 0.059 (100)	5.16 ± 0.006 (87)	5.06 ± 0.022 (85)	4.06 ± 0.052 (68)	3.96 ± 0.037 (67)	2.86 ± 0.024 (48)
5.	Proline (µg/gLFW)	0.900 ± 0.014 (100)	0.973 ± 0.050 (108)	1.006 ± 0.071 (111)	1.113 ± 0.008 (123)	1.286± 0.043 (142)	1.806 ± 0.036(200)

Table 3: Effect of 2,4-D on enzyme characteristics of 10 day old seedlings of *Abelmoschusesculentus*(L.) Moench

S.No	Parameters	Control	1 ppm	2 ppm	3ppm	4ppm	5ppm
1.	NR activity (µmol/gLFW)	68.75 ± 0.021 (100)	59.50 ± 0.017 (86)	51.75 ± 0.005 (75)	48.25 ± 0.004(70)	46.25 ± 0.017 (67)	44.25 ± 0.015 (64)
2.	Catalase activity (µg/gLFW)	0.14 ± 0.002 (100)	0.07 ±0.001 (50)	0.06 ±0.005 (42)	0.05 ±0.017 (35)	0.04 ± 0.003 (28)	0.02 ±0.004 (14)
3.	Peroxidase activity (µg/gLFW)	8.29 ± 0.004 (100)	9.07 ± 0.003 (109)	10.10 ± 0.009 (121)	10.59 ± 0.001 (127)	11.81 ± 0.014 (142)	11.92 ± 0.015 (143)

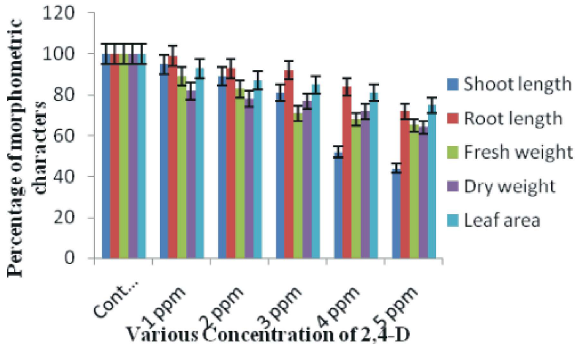

Fig. 1: Effect of 2,4-D on growth characters of 10 day old seedlings of *Abelmoschus esculentus* (L.) Moench

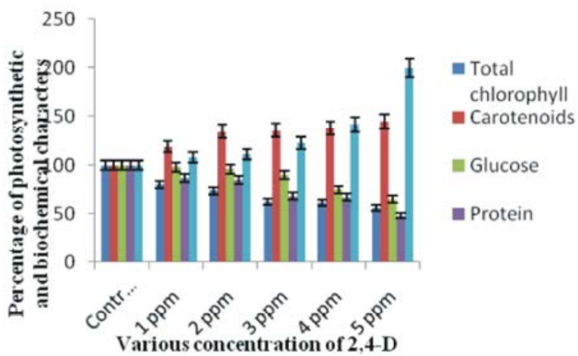

Fig. 2: Effect of 2,4-D on photosynthetic pigments and biochemical characteristics of 10 day old seedlings of *Abelmoschus esculentus* (L.) Moench

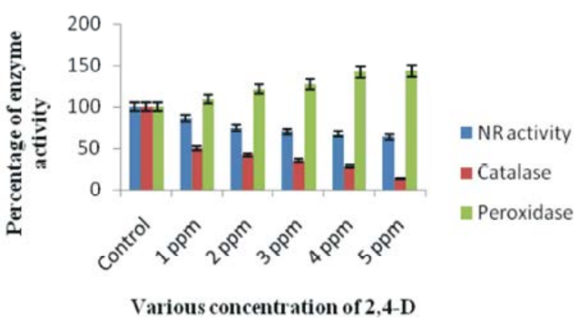

Fig. 3: Effect of 2,4-D on enzyme characteristics of 10 day old seedlings of *Abelmoschus esculentus* (L.) Moench

CONCLUSION

In general, 2,4-D has caused overall inhibition of growth reduction in vital parameters of the Bhendi (*Abelmoschus esculentus*) (L.) Moench. Certain herbicides affect metabolic pathways and systems unique to plants and absent in animals making many modern herbicides the safest crop protection products having essentially no effect on mammals, birds, amphibians or reptiles.

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