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***Original Article***

# The Magnitude Effect of the Inhibitory Effect of 2, 4-D on the Physico-Chemical Nature of *Ipomoea carnea* jacq. (Convolvulaceae) - A weed plant.

***Y. Justin Koilpillai[1], S. Wilson[1] and L. Louis Jesudass[2]***
***[1]Department of Biotechnology, Sathyabama University, Chennai-119.***
***[2]Department of Plant Biology and Biotechnology, St. Xavier's College (Autonomous), Palayamkottai – 627 002, Tamil Nadu.***
****Corresponding Author: E- mail***: justinkoilpillai@yahoo.co.in
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**Abstract**

A field experiment was conducted to find out specifically the magnitude of the inhibitory effect of 2,4-D on the physical and chemical nature of Ipomoea carnea Jacq. The result revealed that the amount of free amino acid, total carbohydrates, soluble proteins and total phenol, have been noticeably reduced where as the proline content has accumulated more when the concentration of 2,4-D is increased as it is interfere with metabolic activity of the experimental system of *Ipomoea carnea*.
***Key words*: *Ipomoea carnea*,** Convolvulaceae, Herbicide, Biochemical Analysis

## Introduction

Weeds are often considered as unwanted and hostile plants to biological system. They had been problematic ever since man became agrarian. Weeds as such are plants, growing in places where they are unwanted. These weeds are controlled by various means, namely exomorphic chemical application, biological control and mechanical eradication. Application of chemicals has been found to be successful to eradicate these unwanted weeds. In that aspect, *Ipomoea carnea* Jacq. (Convolvulaceae) an exotic shrub from the American tropics, now has been become pantropical. Once planted as ornamental along household fences and the banks of canals has now proved to be one of the greatest weed menaces of farm-land in most places. It has spread far and wide as it grows so rapidly in all kinds of soil, such as dry land, wet land, irrigation canal, lakes, ponds etc.

A number of herbicides have been widely used now-a-days for the control of weeds. Many chemicals (with varied properties) have found their way into the field to control the weeds. 2, 4-D (2, 4-dichlro phenoxy acetic acid), one among these chemicals has widely been used as herbicide in recent years, as it is known to reduce the photosynthetic activity by affecting the electron transport system of plants. The effect of 2, 4-D on the metabolic activities depends mainly upon its concentration while applying.

## Materials and Methods

*Ipomoea carnea* Jacq. has been selected to determine the magnitude of effect of the application of 2,4-D as a suitable and eco-friendly herbicide. Experiments were conducted in the Department of Botany, St. Xavier's College, Palayamkottai. The plant materials have mainly been collected for biochemical estimation from dry, aquatic and garden areas (pot cultured).

For pot culture the stem cuttings of *Ipomoea carnea* were selected from aquatic place in the form of 25 cm long and 2 cm dimension. There are about 6 defoliated stem cuttings were planted to a depth of 5 cm in 6 individual pots. The pots containing soil filled with a mixture of garden soil and sand in the ratio of 3:1. Pot culturing experiment were preferred which gave a confined area where in watering could be monitored. Plants were grown under normal condition. The pots were divided into lots, each watered to full saturation capacity soil once in two days. The pots were labeled and arranged randomly at regular interval to ensure uniform environmental conditions on the plants.

The sets of pots were divided into six groups, one as control and the others as experimental i.e., herbicide treated (0.1, 0.2, 0.4, 0.8 and 1.0 % of 2, 4-D). The experiments were carried out in triplicates and results were calculated taking average of the triplicates. The plants were grown up to 30 days.

Everyday 500 ml of tap water was given to the plants from the day of planting onwards. On the 31st day the different pots were treated with different concentration of 2, 4-D (0.1, 0.2, 0.4, 0.8 and 1.0%) in the form of foliar spray. 20 ml of above concentration of 2, 4-D were applied at five sets of pots. The other pot kept as control where there is no application of 2, 4-D. There are 3 times treatment were given with 2 days intervals.

Sampling was done on the 35th day; samples were collected at 2.0 p.m. for biochemical analysis. The leaves of the plants were placed carefully and the analysis for various parameters was done in leaves. Observations were recorded on total carbohydrates, free amino acids, proline content, protein and phenol. For chemical analysis, the following procedures were followed.

(i) Estimation of Total free amino acid – Procedure of Moore, S., and Stein (1948)
(ii) Estimation of Total carbohydrate – Procedure of Hedge, J.E. and Hofreiter, B.T (1962)
(iii) Estimation of soluble proteins – Procedure of Lowry et al., (1951)
(iv) Estimation Total phenol – Procedure of Malick, C.P. and Sing, M.B.(1980)
(v) Estimation of Proline content – Procedure of Bats *et al*., (1973)

## Results and Discussion

The study of amino acids is important as they are the basic units of proteins which is an integrate part of the biomembranes and acts as bio catalyst. As an inhibitory level of 2, 4-D the synthesis of TCA cycle amino acids was reduced and the occumulation of asparagin and glutamine drastically influenced (Wedding & Black, 1962). Earlier, Bourk and Fang (1962) had reported the stimulatory and inhibitory effect of low and high concentration of 2, 4-D on glycolysis in pea tissues.

Smith *et al*., (1947) observed that the total nitrogen in 2, 4-D treated field weed decreased in the leaves and increased in the stems, roots and underground rhizomes. In 1949 Wort reported that in buck weed plant treated with 1,000 parts/$10^6$ of thisodium salt of 2, 4-D; the total nitrogen in the stems and roots increased and that of the leaves decreased four to eight days after the 2,4-D application

There is ample evidence that phenoxy acid herbicides alter the carbohydrate content of plants (Wort, 1964). For example treatment of red kidney bean with 1,000 part/$10^6$ of 2, 4-D resulted in the depletion in stems of reducing and non-reducing sugar, starch, crude fiber and acid hydrolysable polysaccharides. In roots and leaves only non-reducing sugar were depleted (Sell *et al*., 1946).

Protein synthesis has been affected at different levels by herbicides. Audus (1976) suggested two possible levels of control.

(i) at transpiration levels, herbicides regulating DNA directed RNA synthesis, by activating specific RNA polymerase or by derepression
(ii) at translation level, the lipid content of several plants have been shown to be affected by 2,4-D (Sell *et al*., 1949; Zoschike, 1951).

There is evidence from the literature that 2,4-D may affect the activity of amylase, ascorbic oxidase and invertase. It is generally thought that the activity of 2, 4-D invariably altered in an indirect way through effects on the conditions under which the enzyme reacts.

The result of our experiment revealed that, when we compared the amount of amino acid is more in potted plant followed by aquatic and less in dry land (Table 1 and Fig. 1). The analysis of free amino acid (in the 2, 4-d treated plants) indicated that here was a gradual decreases of amino acid content as the concentration of 2, 4-D increased in the treatment (Table 2 and Fig. 2). The decreased amino acid content may be due to the breakdown of peptide bond as observed by Wort (1964).

When compared the amount of total carbohydrate in different habitat namely aquatic, dry and potted plant, the amount is more in potted plant followed by aquatic and less in dry land leaf (Table 3 and Fig. 3). 2, 4-D treated potted plants showed that there was a gradual decreases in total carbohydrate concentration as the concentration of 2,4-D increased in the treatment (Table 4 and Fig. 4).

The decreased carbohydrate concentration content may be due to the break down of glucose molecule.

The result of our experiment revealed that, the amount of soluble protein is more in potted plant followed by aquatic and followed by dry land leaf (Table 5 and Fig. 5). The analysis of soluble protein indicated that there was a gradual decrease in the soluble protein content as the concentration of 2, 4-D increased in the treatment (Table 6 and Fig. 6.). The decreased protein content observed at higher 2, 4-D concentration in leaves might be due to interruption in the synthesis by irreparable damage to protein synthesizing mechanism and increased hydrolysis. Low incorporation of amino acids into protein is also a possible reason for reduction of protein content.

Phenolic compounds play an important role in disease resistance and in young tissue they also help in division and differentiation of cells and regulate growth of the plant (Wain & Taylor 1965, Steward 1968). The result revealed that, the amount of total phenol is more in dry followed by potted and followed by aquatic plant (Table-7 & Fig.7). The analysis of total phenol indicated that there was a gradual decreased in the total phenol content as the concentration of 2,4-D increased in the treatment (Table-9&Fig. 8). The decreased phenol content observed higher concentration of 2, 4-D in the leaves might be due to the interruption in the synthesis by irreparable damage to phenol synthesizing mechanism and increased hydrolysis.

Regarding the amount of proline content is more in aquatic plant followed by potted and followed by dry land leaf (Table 9 and Fig. 9). The analysis of proline content indicated that there was a gradual increase in the proline content as the concentration of 2, 4-D increased in the treatment (Table 10 and Fig. 10). Many reports say that proline tends to accumulate whenever the plant experiences stress. In our results proline content increased in plants when treated with 2, 4-D. According to Wort (1964) 2, 4-D induces the acting of enzymes live proteinase. According to Chen *et al*., (1973) 2, 4-D may interfere with protein synthesis. So the increase in proline may be due to the hydrolyzation of protein or it may be due to the accentual of unused amino acid. The glutamine may also influenced by 2, 4-D and thus leading to the accumulation of proline.

**Table-1**: Amount of free amino in *Ipomoea carnea* from different habitat

| Sl. No | Type of sample | Weight of the sample (in gm) | Amount of free amino acid (in mg/gm) |
|---|---|---|---|
| 1. | Aquatic plant leaf | 2 | 4.25 |
| 2. | Dry land leaf | 2 | 3.0 |
| 3. | Potted plant leaf | 2 | 5 |

**Table - 2**: Effect of different concentration of 2, 4-D on free amino acid of potted plant of *Ipomoea carnea* Jacq. (4 days after treatment)

| Sl.No. | Concentration of 2,4-D in percentage | Weight of the sample (in gm) | Amount of amino acid (in mg/gm) |
|---|---|---|---|
| 1. | Control 0% | 2 | 5.0 |
| 2. | 0.1% | 2 | 4.175 |
| 3. | 0.2% | 2 | 3.125 |
| 4. | 0.4% | 2 | 2.1 |
| 5. | 0.8% | 2 | 1.05 |
| 6. | 1.0% | 2 | 0.52 |

**Table- 3**: Amount of total carbohydrate in *Ipomoea carnea* from different habitat

| Sl.No | Type of sample | Weight of the sample (in gm) | Amount of total carbohydrate (in mg/gm) |
|---|---|---|---|
| 1. | Aquatic plant leaf | 2 | 185 |
| 2. | Dry land leaf | 2 | 140 |
| 3. | Potted plant leaf | 2 | 210 |

**Table - 4**: Effect of different concentration of 2, 4-D on total carbohydrate of potted plant of *Ipomoea carnea* Jacq. (4 days after treatment.)

| Sl.No. | Concentration of 2,4- D in percentage | Weight of the sample (in gm) | Amount of total carbohydrate (in mg/gm) |
|---|---|---|---|
| 1. | Control 0% | 2 | 210 |
| 2. | 0.1% | 2 | 134 |
| 3. | 0.2% | 2 | 125 |
| 4. | 0.4% | 2 | 103 |
| 5. | 0.8% | 2 | 85 |
| 6. | 1.0% | 2 | 32 |

**Table -5**: Amount of soluble protein in *Ipomoea carnea* from different habitat

| Sl.No | Type of sample | Weight of the sample (in mg) | Amount of soluble protein (in mg/gm) |
|---|---|---|---|
| 1. | Aquatic plant leaf | 500 | 57.5 |
| 2. | Dry land leaf | 500 | 40.75 |
| 3. | Potted plant leaf | 500 | 62.5 |

**Table - 6**: Effect of different concentration of 2, 4-D on soluble protein of potted plant of *Ipomoea carnea* Jacq. (4 days after treatment)

| Sl.No. | Concentration of 2,4- D in percentage | Weight of the sample (in mg) | Amount of soluble Protein (in mg/gm) |
|---|---|---|---|
| 1. | Control 0% | 500 | 62.5 |
| 2. | 0.1% | 500 | 50.0 |
| 3. | 0.2% | 500 | 37.5 |
| 4. | 0.4% | 500 | 15.5 |
| 5. | 0.8% | 500 | 7.5 |
| 6. | 1.0% | 500 | 5.25 |

**Table- 7**: Amount of total phenol in *Ipomoea carnea* from different habitat

| Sl.No | Type of sample | Weight of the sample (in gm) | Amount of soluble protein (in mg/100gm) |
|---|---|---|---|
| 1. | Aquatic plant leaf | 2 | 451.5 |
| 2. | Dry land leaf | 2 | 973.5 |
| 3. | Potted plant leaf | 2 | 750.0 |

**Table -8**: Effect of different concentration of 2, 4-D on total phenol of potted plant of *Ipomoea carnea* Jacq. (4 days after treatment)

| Sl.No. | Concentration of 2,4- D in percentage | Weight of the sample (in gm) | Amount of soluble protein (in mg/100gm) |
|---|---|---|---|
| 1. | Control 0% | 2 | 750 |
| 2. | 0.1% | 2 | 670 |
| 3. | 0.2% | 2 | 625 |
| 4. | 0.4% | 2 | 475 |
| 5. | 0.8% | 2 | 335 |
| 6. | 1.0% | 2 | 105 |

**Table- 9**: Amount of proline in different places in *Ipomoea carnea* from different habitat

| Sl.No | Type of sample | Weight of the sample (in mg) | Amount of proline (in mg/gm) |
|---|---|---|---|
| 1. | Aquatic plant leaf | 500 | 5.25 |
| 2. | Dry land leaf | 500 | 3.6 |
| 3. | Potted plant leaf | 500 | 4.5 |

**Table- 10**: Effect of different concentration of 2, 4-D on proline of potted plant of *Ipomoea carnea* Jacq. (4 days after treatment)

| Sl.No. | Concentration of 2,4- D in percentage | Weight of the sample (in mg) | Amount of soluble protein (in mg/gm) |
|---|---|---|---|
| 1. | Control 0% | 500 | 4.5 |
| 2. | 0.1% | 500 | 6.5 |
| 3. | 0.2% | 500 | 7.5 |
| 4. | 0.4% | 500 | 10.0 |
| 5. | 0.8% | 500 | 24.0 |
| 6. | 1.0% | 500 | 35.0 |

***Conclusion***

Finally, regarding the effect of 2, 4-D on the physico-chemical nature of *Ipomoea carnea* was very markedly noted. Among the biochemical components which are tested, the proline content only showed higher amount than other components.

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