Biosciences, Biotechnology Research Asia Vol. **4**(2), 705-712 (2007)

Effect of spray application of 2,4-D on morphological characters of *Hibiscus cannabinus* Linn.

SANJAY I. KAMBLE

Department of Botany and Coordinator, Department of Seed Technology,
Phulsing Naik Mahavidyalaya, Pusad, Dist. Yavatmal (India)

(Received: September 12, 2007; Accepted: October 30, 2007)

ABSTRACT

In present study, the herbicidal activities of 2,4-D on *Hibiscus cannabinus* Linn. studied. The plants were sprayed with aqueous solution of different concentrations of 2,4-D from 100 to 5000 ppm. 2,4-D at all concentrations showed the effects like epinastically curvature, swollen and bending of stem. The leaves turned yellowish and roots became swollen and finally decayed. Vegetative growth of plants was retarded and finally plants dried. The lethal dose of 2,4-D was 500 ppm.

Key words: Herbicide, 2,4-D, Spray application, Morphological characters and *Hibiscus cannabinus* Linn.

INTRODUCTION

Hibiscus cannabinus L. belongs to the family Malvaceae. Commonly known as Bimli, Bimlipatum, Jute and Deccan hemp in different regions of the country. Traditionally cultivated for cordage uses in Africa and Asia, some kenaf is used by small pulp mills primarily in countries like China, India, and Thailand (although much of the acreage in the latter is devoted to roselle (H. sabdariffa L. var. altissma). Since the 1960's, there has been increasing interest in kenaf as an annually renewable source of fiber for the manufacture of newsprint and other pulp and paper products in the United States and other countries.

Plants of *Hibiscus cannabinus* Linn. were raised from seeds collected from naturally growing plants of different places in Nagpur and its environs. They were allowed to grow till they attained the flowering and at this stage plants were plants were sprayed with different concentrations of 2,4-D.

The aqueous solution of herbicide ranging from 100 to 5000 ppm was prepared. Ten pots for each concentrations (100 to 2000 ppm) containing 2 to 3 plants were sprayed. If 2000 ppm was found higher; the lower concentrations were tried to determined lethal dose. Asppe- poly sprayer of one litter capacity did spraying. A small quantity of sodium lauryl sulphate as a surfactant added in the herbicide solution. The spraying was started in month of October 1996 and same experiments were repeated next year also. Spraying was done twice in an hour to make it more effective in the evening hour, when the wind was slow and temperature comparatively lower than that of the day. This help in less evaporation and more absorption of herbicide solution by the leaves. To avoid contamination of different concentrations of herbicide, cardboard was used at the time of spraying application. Six pots were sprayed with water used as control. Field trials were conducted on naturally growing plants in randomly designed plots of size approximately 3 :3 feet's.

The fresh and dry weight of shoots and roots of control as well as treated plants were taken to determined desiccation of plants. Morphological changes were observed daily till the death of plants.

Fig. 1. C: Control. 5 - Plant after spray application at 500 ppm of 2,4-D.

Fig. 2: C - Control field phoyograph.

Fig. 3: C - Control. 1 to 5 - Showing chlorosis on leaves at 100, 200, 300, 400 and 500 ppm of 2,4-D, respectively.

RESULTS

The control plant of *Hibiscus cannabinus* Linn. were growing luxuriantly in the field as well as in earthen pots (Fig. 1c and 2).

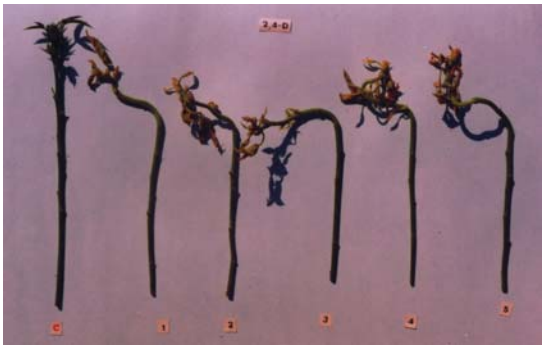

Fig: 4. C - Control. 1 to 5 - Showing epinasty at 100, 200, 300, 400 and 500 ppm of 2,4-D, respectively.

Fig: 5. C - Control. 1 to 5 - Showing necrosis on leaves at 100, 200, 300, 400 and 500 ppm of 2,4-D, respectively.

Fig: 6. C - Control. 1 to 5. Showing rolling effect on leaves at 100, 200, 300, 400 and 500 ppm of 2,4-D, respectively.

This herbicide showed some morphological changes at all concentration i.e. from 100 to 500 ppm after spray treatment. The growth of plants was inhibited as compared to control due to the application of herbicide. The plants treated with 2,4-D started showing some morphological changes after 48 hours of treatment. The epinastically curvature of stem, petiole, and chlorosis, necrosis on leaves were observed progressively at all the concentrations (Fig. 3 and 4). The curvature of the stems at apical nodes was maximum at 300, 400 and 500 ppm. The growing points of the plants were turned downwards.

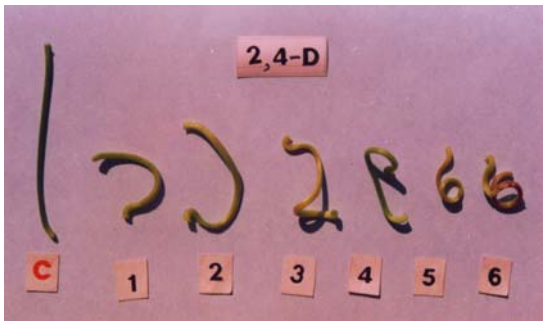

Fig. 7: C - Control. 1 to 5 - Showing rolling of petiole at 100, 200, 300, 400 and 500 ppm of 2,4-D, respectively.

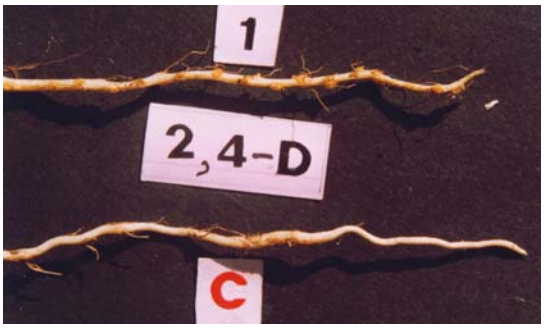

Fig. 9: Control. 1. Root showing nodules at 500 ppm of 2,4-D.

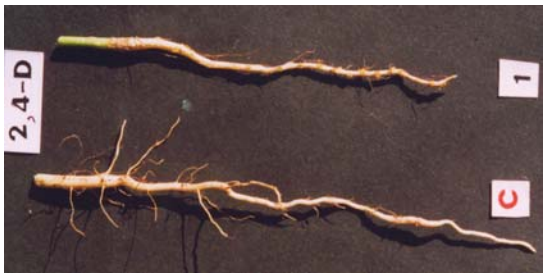

**Fig. 8: C - Control.
1 - Root at 500 ppm of 2,4-D.**

Fig. 10: C - Control. Plant after spray application at 100, 200, 300, 400 and 500 ppm of 2,4-D, respectively

Fig. 11: Field photograph at 500 ppm of 2,4-D.

On fifth day, after application of herbicide the leaves at 400 and 500 ppm showed marked chlorosis (Fig. 3) as well as necrosis (Fig. 5). On sixth day, crumpling of leaves observed and leaves rolled inward and then started drying from margin towards midrib at all concentrations of herbicide (Fig. 6). On seventh day, chlorosis of leaves increased with increases in the concentrations and latter became yellow and ultimately leaves dried off. Owing to this, the lateral and apical vegetative growth of plants was inhibited. On eight day, stem and petiole turned yellow and latter on brownish spots occurred on petiole. Petiole rolled inward at 200, 300, 400 and 500 ppm (Fig. 7). On ninth day, nearly 100 percent of the leaves dried at 500 ppm. The stem, petiole, leaves, root dried completely, and death of plants occurred. Root showed formation of bulb like nodules around it (Fig. 8 and 9). Therefore, this dose was considered as a lethal (Fig. 1 and 10). Similar results were also observed in field trials (Fig. 11).

The vegetative growth stopped with injury to the plant apices and flowering inhibited in treated plants at all concentrations of herbicide. The plants appeared to be frozen due to inhibition of growth.

Table 1: Showing effects of glyphosate on linear growth (in mm) of hypocotyl and radicle of *Hibiscus cannabinus* Linn.

Herbicide	Concentrations (ppm)	Weight of fresh plants		Weight of dry plants	
		Shoot (gm)	Root(gm)	Shoot (gm)	Root(gm)
Control	-	2.79	0.27	1.23	0.20
2,4-D	100	1.84	0.16	0.61	0.13
	200	1.72	0.14	0.42	0.11
	300	1.72	0.09	0.39	0.10
	400	1.51	0.08	0.39	0.05
	500	1.43	0.08	0.36	0.04

In the next 5 to 6 days, the plants sprayed with 100 to 500 ppm concentrations of herbicide also dried. Fresh and dry weight of shoots and roots of treated and untreated plants were noted (Table 1).

Fresh weight decreased in both shoot and roots as the concentrations of herbicide increased from 100 to 500 ppm. At the same concentrations decrease was found in dry weight also (Table 1).

DISCUSSION

This herbicide found to be effective by inducing growth malformation, the epinastically curvature of stems and petioles at all concentrations. Epinastically curvature was occurred due to the unequal elongation of cortical cells and it has been supported by Zimmerman (1942) and Marth and Mitchell (1944) on *Datura,* Beal (1944b) on *African marigold*, Hammer and Tukey (1944b) on bind weed, Hildebrand (1946) on *Eichornia crassipes,* Weaver (1946) on red kidney bean, Kumar *et. al*. (1949) on *Cassia tora*, Asana *et. al* (1950) on some varieties of wheat, D'Amato (1957) on *Lupinus albus*, Nikolaevskij (1959) on *Glageschia*, Lal and Rao (1960) on *Cassia tora*, *Cassia occidentalis, Lantana spp., Archyranthes aspera* and *Malvasrum spp.,* Mohan Ram and Satsangi (1963) on *Ricinus communis*, Miller *et. al*. (1963) on cotton, Khosla (1967) on *Cassia tora*, and *Ruellia tuberosa,* Rubin and Gritasenta (1968) on *Amaranthus retroflexus* and *Chenopodium album*, Berquist (1971) on *Myriphyllum spicatum*, Coble and Slife (1971) on

Ampelamus abides, Bakale (1976, 1978, and 1979b) on *Cress crecita, Alternanthera, Polygonoides* var. *erecta and Xanthium strumarium,* Kolhe (1979) on *Tephrosia hamiltonii, Solanum surattense* and *Celosia argentea,* Hadke (1980) on *Psoralea corylifolia* and *Euphorbia geniculata*, Deshmukh (1981) on *Cassia occidentalis, Carchorus olitorious* and *Lagasca mollis,* Srinivasu (1986) on *Parthenium hysterophorus*, Dhanpal *et al*. (1989) on several weeds, Ferrel *et al.* (1989) on *Euphorbia esula*, Kasera and Sen (1990) on *Chenopodium album*, and *Plantago ovata*, Tripathi *et. al.* (1992) on *Lantana camera*, Jain (1993) on *Chenopodium album*, Gopal (1993) on *Medicago sativa*, Bobde (1993) on *Crotolaria juncea*, Suresh babu and Muniyappa (1994) on *Solanum elaegnifolium,* Mukharji (1994) on *Abutilon indicum* and Kulkarni (1998) on *Crotolaria medicaginea* var. *laxurians.*

The inhibition of apical shoots appeared stunted growth till the death of plants progressively observed at all concentrations of herbicide. It has been reported by Weaver (1946) on bean spp. That 2,4-D was effective and it checked the height. Kelly (1949) on bean reported stunted growth of plants due to 2,4-D treatment. Khosla (1967) on *Achyranthes aspera*, *Cassia tora*, and *Ruellia tuberosa* reported vegetative growth inhibition due to application of 2,4-D. Bakale (1976, 1978a, and 1978b) on *Cress crecita, Alternanthera, Polygonoides* var. *erecta and Xanthium strumarium,* reported inhibition of lateral and apical growth of stem. Raj and Tripathi (1986) on *Galinsaga ciliata,* and *Galinsaga parriflora* reported inhibition of growth. Srinivasu (1986) on *Parthenium hysterophorus* reported inhibition of apical and lateral shoots. Dhanpal *et al*. (1989) observed the growth of several weeds reduced by 2,4-D. Kasera and Sen (1990) on *Chenopodium album*, *Chenopodium murale* and *Plantago ovate* reported reduction of growth within few hours after applications of different concentrations of herbicide. Tripathi *et. al.* (1992) noticed stunted of stem growth in *Lantana abcamera* application of 2,4-D. Jain (1993) on *Chenopodium album*, Gopal (1993) on *Medicago sativa* and Bobde (1993) on *Crotolaria juncea* reported inhibition of shoots growth of these plants due to spray application 2,4-D. Suresh babu and Muniyappa (1994) on *Solanum elaegnifolium* and Kulkarni (1998) on *Crotolaria medicaginea* var. *laxurians* reported reduced growth of plant by 2,4-D.

In present study, Swelling at apical nodes of shoot was observed by application of this herbicide. The swelling of apical nodes might be due to proliferation of cortical tissues by resuming meristematic activities. Hammner and Tukey (1944ab) on blind weed, Beal (1944 b) on *African marigold*, Weaver (1946) on red kidney bean, Williams *at. el.* (1960) on Cocklebur, Rubian and Gritsaenta (1968) on *Chenopodium album* and *Amaranthus retroflexus*, Bakale (1978) on *Alternanthera, Polygonoides,* Deshmukh (1981) on *Cassia occidentalis* and *Lagasca molli ,* Srinivasu (1986) on *Parthenium hysterophorus,* Jain (1993) on *Chenopodium album*, Gopal (1993) on *Medicago sativa* and Bobde (1993) on *Crotolaria juncea*, and Kulkarni (1998) on *Crotolaria medicaginea* var. *laxurians* reported similar results due to application of 2,4-D.

The leaves of the plants become yellow at base due to chlorosis, which then progressed towards apex of the plant. Later on, leaves rolled inward due to drying and clumping of margin to midrib. Similar results were reported by Mitchell and Brown (1945) on Morning glory, Fites et.al. (1964) on *Datura stramonium*, Cobel and Slife (1971) on *Ampleamus albidus*, Martin and Fletcher (1972) on lettuce, Bakale (1976 and 1978) on *Cress crecita, Alternanthera, Polygonoides,* Srinivasu (1986) on *Parthenium hysterophorus,* Dhanpal *et al*. (1989) on several weeds, Tripathi *et. al.* (1992) *Lantana abcamera,* Jain (1993) on *Chenopodium album*, Gopal (1993) on *Medicago sativa* and Bobde (1993) on *Crotolaria juncea*, and Kulkarni (1998) on *Crotolaria medicaginea* var. *laxurians* reported chlorosis and necrosis of leaves due to application of 2,4-D.

The flowers on the inflorescences dried and fell down at higher concentrations of 2,4-D were observed in the present study. Mitchell and Brown (1945) on Morning glory reported that new flowers failed to develop due to 2,4-D treatment. Khosla (1967) on *Cassia tora*, and *Ruellia tuberosa,* reported delaying in flowering and fruiting. Pearse (1970) on Homeria spp. noticed that 2,4-D prevented flowering in the weed. Bakale (1976) on *Cress*

crecita observed complete inhibition of flowering. Srinivasu (1986) on *Parthenium hysterophorus* complete inhibition of flowering. Jain (1993) on *Chenopodium album* Gopal (1993) on *Medicago sativa and* Bobde (1993) on *Crotolaria juncea*, and Kulkarni (1998) on *Crotolaria medicaginea* var*. laxurians* found inhibition of flowering, discolored and dried inflorescences due to of 2,4-D treatment.

In present study, the fresh and dry weight of shoots and roots were taken and concluded that there was progress desiccation of tissue in plants. Similar observation were reported by Muniyappa *et. al.* (1980) on *Parthenium hysterophorus* and Srinivasu (1986) on *Parthenium hysterophorus,* Raj and Tripathi (1986) on *Galinsaga ciliata,* and *Galinsaga parriflora* Blackshaw (1990) on *Salsola iberica* and *Kochia scoparia*, Jain (1993) on *Chenopodium album* Gopal (1993) on *Medicago sativa* and Bobde (1993) on *Crotolaria juncea*, Arya (1994) on *Galinsoga parriflora* and Kulkarni (1998) on *Crotolaria medicaginea* var*. laxurians*.

REFERENCES

1. Asana, R.D., Verma, G. and Mani, V. S. Some observations on the growth and development of two varieties of wheat. *Physiol. Plantarm*. **3:** 334 -352 (1950).
2. Bakale V.L. Influence of spray application of weedicides on *Cress crecita* Linn. *Biovigyanum*. **2**: 31-38 (1976).
3. Bakale V.L. Effect of foliar application of weedicides on *Alternanthera, Polygonoides* var*. erecta* Linn. *The Botanique*. **10**(1-4): 89-101 (1989a).
4. Bakale V.L. Spray effects of herbicides on *Xanthium strumarium* Linn*. The Botanique*. **10** (1-4): 53-65 (1989b).
5. Beal, G.M. Further observations on the telomorphic effect of certain growth regulating substances on *African marigold*. *Bot. Gat*. **106**: 165- 178 (1944b).
6. Berquist, E.T. Ecological and Morphological effects on Myriphyllum *spicatum* Linn, in a Tennessee valley reservoir. *Diss. Abstr. Internet*. B. **32** (116)**:** 137 (1971).
7. Blackshaw, R.E. *Salsola iberica* and *Kochia scoparia*, control in dry land corn (Zey *mayz*). *Weed Technology*. **4:** 631- 634 (1990).
8. Bobde, S.N. Comparative effects of herbicides on *Crotolaria juncea* Linn. Ph.D. Thesis, Nagpur University, Nagpur (1993).
9. Coble, H.D. and Slife, F.W. Root diffusions in *Ampelamus albidus* caused by 2,4-D. *Weed Science*. **19:** 1-3 (1971).
10. D'Amato, F. Morphological and histological effect of 2,4-D on *Lupinus albus. Atti. Or. Toscena. sci. Nat. Pisa*. **64:** 9 (1957).
11. Deshmukh, V.R. Effect of weedicide on Cytomorphology of Cassia *occidentalis, Carchorus olitorious* and *Lagasca mollis.* Ph.D. Thesis, Nagpur University, Nagpur (1981).
12. Dhanpal, G.N., Venkata Reddy, B.M., Ramegowda and Bommegowda, A.Screening of herbicide for crops under Bangalor condition. *Mysore J. Agric. Sci*. **23:** 159-163 (1989).
13. Ferrel, M.A., Whittson, T.D. and Alley, H.P. Control of Euphorbia *esula* with growth regulators herbicide combinations. *Weed Technology*. **3:** 479- 484 (1989).
14. Fites, R.C., Slife, F.W. and Hanson, J.B. Translocation and metabolism of radioactive 2,4-D in *Datura stramonium. Weeds*. **12**: 180-183 (1964).
15. Gopal, K.R. Herbicidal effects on cytomorphology of weed *Medicago sativa.* Ph.D. Thesis, Nagpur University, Nagpur (1993).
16. Hadke, S.N. Effect of herbicides on cytomorphology of weed *Psoralea corylifolia* and *Euphorbia geniculata.* Ph.D. *Thesis, Nagpur* University, Nagpur (1980).
17. Hammer, C.L. and Tukey, H.B. The herbicidal action of 2,4-D, 2,4,5-T on bind weed. *Science*. **100**: 254- 155 (1944a).
18. Hammer, C.L. and Tukey, H.B. Selective

herbicidal action of mid summer and fall application of 2,4-D. *Bot. Gaz*. **106**: 232- 243 (1944b).

19. Hildebrand, E.M. Herbicidal action of 2,4-D on *Eichornia crassipes. Science.* **103**: 477-479 (1946).
20. Jain, S.B. Cytomorphological effects of weedicides on weed Chenopodium *album. Ph.D. Thesis*, Nagpur University, Nagpur (1993).
21. Kasera, P.K.and Sen, D.N. Effect of some new formulation of 2,4-D herbicide on metabolic activity of Chenopodium *album* and *Plantago ovata* in Indian arid agro ecosystem (1990).
22. Kelly, S. The effects of temperature on the susceptibility of plant to 2,4-D. *Pl. Physiol*. **24**: 534-536 (1949).
23. Khosla, S.N. Effect of herbicides on cytomorphology of weed *Cassia tora* and *Ruellia tuberosa. Ph.D. Thesis*, Bombay University, Bombay (1967).
24. Kolhe, R.R. Effect of herbicides on cytomorphology of weed *Tephrosia hamiltonii, Solanum surattense* and *Celosia argentea. Ph.D. Thesis*, Nagpur University, Nagpur (1979).
25. Kulkarni, G.B. Effects of agrochemicals on *Crotolaria medicaginea* var. *laxurians. Ph.D. Thesis*, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (1998).
26. Kumar, L.S.S., Solomon, S., and Rao, M.V.V. Preliminary studies in the use of synthetic hormones as weed killers in the Bombay province. *Proc. Indian Acad. Sci*. **30**: 243-248 (1949).
27. Lal, M.S. and Rao, S.N. Effects of some growth regulators on *Cassia tora*, *Cassia occidentalis, Lantana spp., Archyranthes. Allahbad Farmer*. **34**: 292-308 (1960).
28. Marth, P.C. and Mitchell, J.W. 2,4-D as a differential herbicide. *Bot. Gaz*. **105**: 224-232 (1944).
29. Martin, J.A. and Fletcher, J.J. The effects of sub-lethal doses of various herbicides on lettuce. *Weed Res*. **12**: 268-271 (1972).
30. Miller, T.H., Kempner, H.M., Wilkerson, J.A. and Roy, C.L. Response of cotton to 2,4-D and related phenoxy herbicide. *Tech. Bull. Us. Dep. Agric*. **1289**: 28 (1963).
31. Mitchell, J.W. and Brown, J.N. Effect of 2.4-D on readily available carbohydrate constituents in annual morning glory. *Bot. Gaz*. **107**: 120-129 (1945).
32. Mohan Ram, H.Y. and Satsangi, A. Histomorphological responses of *Ricinus communis* to 2,4-D. *Phytomorphology*. **13**: 267-274 (1963).
33. Mukharji, A. Effects of certain phenoxy herbicides on mortality, growth and seed output of *Abutilon indicum* (Linn.) S.W. *Acta. Botanica. Hungarica*. **38** (1/4): 335-343 (1994).
34. Muniyappa, T.V., Ramchandra Prasad, T.V. and Krishnamurthy, K. Comparative effectiveness of mechanical and chemical method of control of *Parthenium hysterophorus* Linn. *Indian J. Weed Sci*. **12 (2):** 137-144 (1980).
35. Nikolaevskij, V.G. The herbicide 2,4-D and nasty movement. *Priroda*. **48** : 10 (1959).
36. Pearse, G.A. Progress in research on noxious weeds. *J. West. Agric. Aust*. **11**: 139-143 (1970).
37. Raj, J.P.N. and Tripathi, R.S. Population regulation of on *Galinsaga ciliata* (Raf.) black, and *Galinsaga parriflora* Car. Effect of 2,4-D application at different growth stages and light region. *Weed Res*. **26**: 59-67 (1986).
38. Rubin, S.S. and Gritasenta, A.M. The effect of 2,4-D on the structure of plants. *Bot. Gaz*. **53**: 377- 37 (1968).
39. Srinivasu, T. Effect of weedicide on weed *Parthenium hysterophorus* Linn. *Ph.D. Thesis*, Nagpur University, Nagpur (1986).
40. Suresh Babu, V. and Muniyappa T.V. Comparative efficacy of post-emergent herbicides on the control of *Solanum elaegnifolium. Indian J. Agron. Sci*. **26** (3-4): 22-27 (1994).
41. Tripathi, B., Verma, T.S. and Sharma, H.L. Chemical control of *Lantana camera* and its use as organic manure. *Indian J. Agron. Sci*. **37**(1)**:** 135-139 (1992).
42. Weaver, R.J. Effect of spray application of 2,4-D on red kidney bean and soybean plants. *Bot. Gaz*. **107**: 532-539 (1946).
43. Williams, M.C., Slife, F.W. and Hanson, J.B. Absorption and translocation of 2,4-D in

several annul broad leaves. *Weeds*. **8**: 244-255 (1960).

44. Zimmerman, P.W. and Hitchcock, A.E. Substituted phenpxy and benzoic acid growth substance and relation of structure to physiological activity. *Contrib. Boyce. Thompson. Inst*. 329-343 (1942).

45. Dempsey, J. M. Fiber crops. Univ. of Florida Press (1975).