

Effect of Agrochemical (2,4-D) on Morphological Aspects of *Cassia tora* Linn

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Present investigation carried out in the botanical garden and research laboratory of the college. The herbicidal activities of agrochemical (2,4-D) on *Cassia tora* Linn. have been studied. The morphological responses might produce some light on the manner by which this compound affected on plants. The plants were sprayed with aqueous solution of different concentrations of herbicide from 50 to 1000 ppm. 2,4-D at all concentrations showed the effect like epinasty, bending of stem and petiole, chlorosis and necrosis on leaves. The leaves burned, roots become swollen and finally decayed. Vegetative growth of plants was retarded and finally plants dried, the lethal dose of 2,4-D was 375 ppm.

Key words: 2,4-D, Morphology, *Cassia tora* Linn., Epinasty, Chlorosis, Necrosis and Nodules.

Plants of *Cassia tora* Linn. were raised from seed collected from naturally growing plants of different places in Yavatmal District and its environs. They were allowed to grow three months till they attained the flowering and at this stage plants were sprayed with different concentrations of 2,4-D.

The aqueous solution of herbicide ranging from 50 to 1000 ppm was prepared as per procedure. One thousand ppm of 2,4-D solution was used as stock solution to prepare lower concentrations. The concentrations of 2,4-D ranging from 50 to 1000 ppm were used. Lower concentrations than 50 ppm were used whether it was found to be lethal dose. Higher concentrations were tried where found

to be not the lethal dose. The pH value of each concentrations of herbicide was determined using Blackman's pH meter.

Ten pots of for each concentration (50 to 1000 ppm) containing 2 to 3 plants were sprayed. If 1000 ppm was found higher, the lower concentrations were tried to determine lethal dose. The spraying was started in the month of October 2013. Spraying was done twice in an hour to make it more effective in the evening hours, when the wind was slow and temperature comparatively lower than of day. This help in less evaporation and more absorption of herbicide solution by the leaves. To avoided contamination of different concentration of herbicide, cardboard was used at the time of spraying application. Five pots were sprayed with water used as control. Field trials were conducted on naturally growing plants in randomly designed plots of size approximately 3X3 feet's.

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

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RESULTS

The control plants of *Cassia tora* Linn. were growing luxuriantly in the field as well as in earthen pots (Figs. 1 and 9c).

The herbicide showed some morphological changes at all concentrations, that is, from 75 to 375 ppm after spray treatment. The growth of the plants was inhibited as compared to control due

to application of herbicide. The plants treated with 2,4-D started showing some morphological changes after 48 hours of treatment. The epinasty and swelling of stem, petiole and chlorosis on leaves were observed progressively at all concentrations. The curvature of stems at apical nodes was more 225, 300 and 375 ppm. The growing points of plants were turned downwards.

Table 1. Effect of herbicide on fresh and dry weight of *Cassia tora* Linn

Herbicide	Concentration in ppm	Weight of the fresh plants		Weight of the dry plants	
		Shoot (in gm)	Root (in gm)	Shoot (in gm)	Root (in gm)
Control	—	2.69	0.28	1.26	0.22
2,4-D	75	1.80	0.17	0.61	0.13
	150	1.69	0.15	0.52	0.12
	225	1.68	0.10	0.40	0.09
	300	1.52	0.8	0.39	0.05
	375	1.39	0.7	0.36	0.04

Note:- Average weight based on ten plants.

On fifth day, after application of 2,4-D the leaves at 225, 300 and 375 ppm showed marked chlorosis (Fig. 3) as well as necrosis (Fig. 4) on leaflets. On six day, there was crumpling of leaflets, leaflets rolled inward and then started drying from margin towards midrib at all concentrations of herbicide (Fig. 5). On seventh day, chlorosis of leaflets increased with increasing concentrations and latter became yellow and ultimately leaves dried off showing burning effect (Fig. 6). Owing to this, the lateral and apical vegetative growth

of plants was inhibited. On eighth day, stem and petiole turned yellow and later on the brownish spots occurred on petiole. Petiole rolled inward at 225, 300, and 375 ppm (Fig. 7). On ninth day, nearly 100 percent of the leaves dried at 375 ppm. The stem, petiole, leaves and root dried completely and death of the plants occurred. Roots showed formation of bulbous outgrowth like nodules around it (Fig. 8). Therefore, this dose was considered as a lethal (Fig. 9_s). Similarly results were also observed in field trials (Fig. 10).



Fig. 1. Control field photograph



Fig. 2. C- Control. 1 to 5- Stem showing epinasty at 75, 150, 225, 300 and 375 ppm of 2,4-D, respectively



Fig. 3. C- Control. 1 to 5- Leaves showing chlorosis on leaflets at 75, 150, 225, 300 and 375 ppm of 2,4-D, respectively



Fig. 4. C- Control. 1 to 5- Leaves showing Necrosis on leaflets at 75, 150, 225, 300 and 375 ppm of 2,4-D, respectively.



Fig. 5. C- Control. 1 to 5- Leaves showing rolling of leaflets at 75, 150, 225, 300 and 375 ppm of 2,4-D, respectively



Fig. 6. C- Control. 1 to 5- Leaves showing burning effect on leaflets at 75, 150, 225, 300 and 375 ppm of 2,4-D, respectively



Fig. 7. C- Control. 1 to 5- Petiole showing bending at 75, 150, 225, 300 and 375 ppm of 2,4-D, respectively

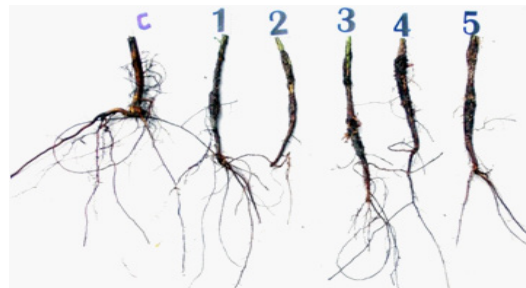


Fig. 8. C- Control. 1 to 5- Roots showing nodules at 75, 150, 225, 300 and 375 ppm of 2,4-D, respectively



Fig. 9. C- Control. 1 to 5- Plants after spraying application at 75, 150, 225, 300 and 375 ppm of 2,4-D, respectively

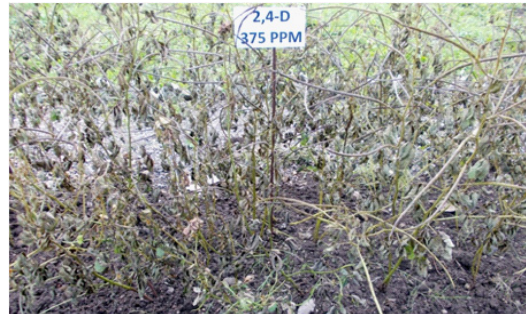


Fig. 10. Field photograph at 375 ppm of 2,4-D

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

In the next five or six days, the plants sprayed with 75 to 375 ppm concentrations also dried. Fresh weight and dry weight of shoots and roots of treated and untreated plants were noted (Table1).

Fresh weight decreased in both shoots and roots as the concentrations of the 2,4-D increased from 75 to 375 ppm. At the same concentrations decrease was found in dry weight also.

DISCUSSION

This herbicide was found effective by inducing growth malformation, the epinasty curvature of stems and petioles at all concentrations. The epinasty was occurred due to the unequal elongation of cortical cells and it had been supported by Zimmerman and Hitchcock (1942) and Marth and Mitchell (1944) on *Datura*, Beal (1944b) on African marigold, Hammer and Tukey (1944a) on bind weed, Hilderbrand (1946) on *Eichhornia crassipes*, Weaver (1946) on red kidney bean, Kumar *et al.* (1949) on *Cassia tora*, D'Amato (1957) on *Lupinus albus*, Nikolaevskij (1959) on *Gladeschia*, 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*, Coble and Slife (1971) on *Ampelamus albidus*, Bakale (1979, 1978 and 1979) on *Cress cretica*, *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) *Cassia occidentalis*, *Corchorus olitorius* and *Lagasca mollis*, Srinivasu (1986) on *Parthenium hysterophorus*, Dhanpal *et al.* (1989) on several weeds, Ferrell *et al.* (1989) on *Euphorbia esula*, Kaseera and Sen (1990) *Chenopodium album*, *Chenopodium murale* and *Plantago ovate*, Tripathi *et al.* (1992) on *Lantana camera*, Jain (1993) on *Chenopodium album*, Gopal (1993) on *Medicago sativa*, Bobde (1993) on *Crotolaria juncea*, Kulkarni (1998) on *Crotolaria medicaginea* var. *luxurians* and Kamble (1999 and 2007) on *Hibiscus cannabinus*.

The inhibition of apical shoot appeared stunted in growth till the death of plants progressively observed at all concentrations of herbicide. It had been reported by Weaver (1946) on two *bean spp.* that 2,4-D was effective and it checked the height. Kelley (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 2,4-D. Bakale (1976, 1978 and 1979) on *Cressa cretica*, *Alternanthera polygonoides* var. *erecta* and *Xanthium strumarium* reported inhibition of lateral and apical growth of stem. Raj and Tripathi (1986) on *Galinsoga ciliata* and *Galinsoga parviflora* reported inhibition of growth. Srinivasu (1986) on *Parthenium hysterophorus* reported inhibition of the apical and lateral shoots. Dhanpal *et al.* (1989) observed the growth of several weeds reduced by 2,4-D. Kaseera and Sen (1990) on *Chenopodium album*, *Chenopodium murale* and *Plantago ovate* reported reduction of growth within few hours after application of different concentrations of 2,4-D. Tripathi *et al.* (1992) noticed stunted of stem growth in *Lantana camera* by sodium salt of 2,4-D. Jain (1993) on *Chenopodium album*, Bobde (1993) on *Crotolaria juncea*, Gopal (1993) on *Medicago sativa* reported inhibition of shoot growth of these plants due to spray application of 2,4-D. Kulkarni (1998) on *Crotolaria medicaginea* var. *luxurians* and Kamble (1999 and 2007) reported reduced growth of plants by 2,4-D.

In the present investigation, swelling at apical nodes of shoot was observed by application of this agrochemical. The swelling of apical nodes might be due to proliferation of cortical tissue by resulting meristematic activity. Hamner and Tukey (1944a,b) on bind weed, Beal (1944b) on African marigold, Weaver (1946) on kidney bean, Williams *et al.* (1961) on *Cocklebur*, Rubin and Gritasenta (1986) on *Chenopodium album* and *Amaranthus retroflexus*, Bakale (1979) on *Alternanthera polygonoides*, Deshmukh (1981) on *Cassia occidentalis* and *Lagasca mollis*, Srinivasu (1986) on *Parthenium hysterophorus*, Jain (1993) on *Chenopodium album*, Bobde on *Crotolaria juncea*, Gopal (1993) on *Medicago sativa*, Kulkarni (1998) on *Crotolaria medicaginea* var. *luxurians* and Kamble (1999 and 2007) on *Hibiscus cannabinus* reported similar results due to the application of 2,4-D.

The leaves of the plants became yellow at base due to chlorosis which then progressed towards the 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 (1946) on Morning glory, Fites *et al.* (1964) on *Datura stromanium*, Coble and Slife (1971) on *Ampelamus albidus*, Martin and Fletcher (1972) on lettuce, Bakale (1976, 78 and 79) on *Cressa cretica* and *Alternanthera polygonoides*, Srinivasu (1986) on *Parthenium hysterophorus*, Dhanpal *et al.* (1989) on various weeds, Tripathi *et al.* (1992) on *Lantana camara*, Jain (1993) on *Chenopodium album*, Bobde (1993) on *Crotalaria juncea*, Gopal (1993) on *Medicago sativa*, Kulkarni (1998) on *Crotalaria medicaginea* and Kamble (1999 and 2007) *Hibiscus cannabinus* reported chlorosis and necrosis of leaves due to application of 2,4-D.

The flowers on the inflorescence dried and fell down at higher concentrations of 2,4-D was observed in the present investigation. Khosla (1967) on *Cassia tora* and *Ruellia tuberosa* reported delaying in flowering and fruiting. Pearce (1970) on *Homeria spp.* noticed that 2,4-D prevented flowering in the weed. Bakale (1976) on *Cressa cretica* observed complete inhibition of flowering. Srinivasu (1986) on *Parthenium hysterophorus* observed complete inhibition of flowering. Jain (1993) on *Chenopodium album*, Gopal (1993) on *Medicago sativa*, Bobde (1993) *Crotalaria juncea*, Kulkarni (1998) on *Crotalaria medicaginea* and Kamble (1999 and 2007) on *Hibiscus cannabinus* found inhibition of flowering, discolored and dried inflorescence due to 2,4-D treatment.

In present investigation, dry weight and fresh weights of the shoots and roots were taken and concluded that there was a progressive desiccation of tissues in plant. Similar observations were reported by Muniyappa *et al.* (1980) and Srinivasu (1986) on *Parthenium hysrerophorus*, Raj and Tripathi (1986) on *Galinsoga ciliata* and *Galinsoga parviflora*, Blackshaw (1990) on *Salsola iberica* and *Kochia scoporia*, Jain (1993) on *Chenopodium album*, Bobde (1993) on *Crotalaria juncea*, Gopal (1993) on *Medicago sativa*, Kulkarni (1998) on *Crotalaria medicaginea* and Kamble (1999 and 2007) on *Hibiscus cannabinus*.

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