Effect of 2, 4 – Dichlorophenoxyaceticacid on the Linear Growth of Seedlings of Some Weeds

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Several workers (Everson and Dunham, 1951; Graceduenas and Kommedhal 1958; Hamner *et al.* 1946; Johnson and Muzik, 1961; Mitchell and Brown, 1947; Mohan Ram and Satsangi, 1964 and Taylor, 1946) have observed that 2, 4-D (2, 4-dichlorophenoxy acetic acid) inhibited the root and shoot growth accompanied with certain morphological abnormalities. Arakeri and Dunham (1950), Audus (1949), Behrens and Howard (1963) and Hansen and Buchholtz (1952) have correlated the inhibition of root growth with the pH of the solutions. They found that increasing acidity or alkalinity of the solutions inhibited the linear growth of roots and at extreme ranges caused injury to the growing tissue also.

The present investigation was undertaken to study whether 2, 4-D affects shoot or root more effectively and at what stage in the case of *A. aspera*, *C. tora* and *R. tuberosa*.

MATERIALS AND METHODS

A large number of seeds of *C. tora* were rubbed individually on a fine grained sand paper at their micropylar end and were soaked in tap water for 24 hours. Seeds of *A. aspera* were directly soaked in tap water. Seeds of both these weeds were germinated separately in folded blotting papers kept slanting in beakers filled 1/3 with tap water. After 48 hours the blotting papers were unfolded and seedlings of each species with uniform length of the radicle were divided into a number of groups each consisting of four seedlings. Seedlings of *R. tuberosa* were grown in a petridish over a moist blotting paper from seeds already soaked in tap water for 24 hrs.

Seedlings of all these three species selected were blotted dry and then immersed in 15 ml of tap water (control), 100, 200, 400, 600, 800 and 1000 ppm of 2, 4-D (aqueous solutions) in 3" petridishes over moist blotting papers. Measurements of linear growth were taken after 72 hours. Observations were made regarding their morphological abnormalities with reference to the respective lethal doses. The differences observed in the linear growth of the hypocotyl

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and the radicle in the treated seedlings and those of control have been graphically presented.

In *A. aspera* and *C. tora* 100 ppm was found lethal in the first instance, hence lower doses, viz. 20, 40, 60 and 80 ppm were used.

RESULTS

At 20, 40, 60 and 80 ppm the hypocotyl of the seedlings of *A. aspera* swelled at the base. Development of the lateral roots was inhibited to small protuberances. A swelling resulted near the tip of the radicle, but the actual tip continued to grow (Fig. 2). The seedlings in the control developed healthy roots. Growth of lateral roots was inhibited more at higher concentrations. At 80 ppm some seedlings exhibited swelling of the tip of the radicle (Fig. 3) and the portion behind the tip turned brown. Since the first signs of injury to the radicle occurred at 80 ppm and the hypocotyl was not affected the radicle was taken to be more sensitive than the hypocotyl. At 100 ppm both the radicle and the hypocotyl were affected.

Except the lower dose of 20 ppm all higher concentrations inhibited the growth. The hypocotyl was swollen forming a tumour towards the apex behind which it was normal as in control (Fig. 4). The cotyledons in the treated seedlings did not come out of the seed coat. Linear growth of the radicle and the lateral roots was inhibited at all concentrations. The tip of the radicle turned brown at 20 ppm indicating injury and this injury progressed along rest of the radicle towards the base in 40, 60 and 80 ppm concentrations. At 80 ppm, the base of the hypocotyl also turned brown upto a certain length. However, at 100 ppm all the seedlings died. At 20 ppm very little growth of the radicle took place but the hypocotyl was not much affected (Fig. 1). Since, the growth of the radicle was suppressed at 20 ppm and the hypocotyl was not affected at 80 ppm, the former is evidently more susceptible.

The growth of the seedlings of *R. tuberosa* was completely checked at 100 ppm (Fig. 1). Growth of lateral roots was also inhibited. The tip of the radicle turned brown at 100 ppm and this injury progressed towards the base upto almost half of the length. The margins of the cotyledons and the base of the hypocotyl turned brown but the seedlings did not die. Complete death of the seedlings occurred at 200 ppm within 72 hours. Therefore, the lethal dose for *R. tuberosa* at the seedling stage is 200 ppm and 100 ppm is the sub-lethal dose. Since the extent of injury was more to the radicle than the hypocotyl it is inferred that the radicle is more susceptible to the lethal action of 2, 4—D.

Morphological deformities, such as swelling of the radicle and the hypocotyl as in *A. aspera* did not develop in *R. tuberosa*.

DISCUSSION

Johnson and Muzik (1960) observed that foliar applications of 2, 4-D caused malformations on the roots. The primary root elongation was inhibited by the foliar application of 2, 4-D except at 500 ppm amine salt which appeared to stimulate growth. Lateral roots of treated plants were more in number but shorter in length with tumour like swellings. In the present study also stimulation of lateral roots was observed on whole of the length of the radicle of *A. aspera* but their linear growth was arrested (Fig. 5). Mohan Ram and Satsangi (1963) found inhibition of the root growth in seedlings raised from 2; 4-D treated castor seeds. There was suppression of elongation with fasciation of the main root. They correlated the suppression of shoot growth to the failure of emergence of the secondary roots to come out of the cortex, which had expanded radially and accommodated their growth. Many protuberances representing the inhibited lateral roots on the radicle of *A aspera* were seen (Fig. 5).

Andus (1949) elucidated the cause of inhibition of root growth in *Lapidium sativum* by 2, 4-D on the basis of pH relationship of the concentrations, He inferred that the growth rate exhibited considerable variations, but the main trend was a progressive increase in inhibition as the pH range proceeded from the alkaline to the acidic side.

The pH values of the concentrations of 20 to 80 and 100-200 ppm of 2, 4-D ranged from 6.7 to 5.9 and 5 5 to 5.3 respectively. As the concentrations rose from lower to higher ones, they became more acidic and the linear growth of the radicle was checked more severely of all the three kinds of seedlings at higher concentrations.

On the other hand Hansan and Buchholtz (1952) reported that greater uptake of 2, 4-D occurred at the lower pH value because of less dessociation of 2, 4-D molecules or pH affected the plant material itself so that the membrane becomes more permeable. Arkeri and Dunham (1950) found greater injury to corn at low pH following pre-emergence application of 2, 4-D (butyl ester).

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SUMMARY

Seedlings of *Achyranthes aspera* L., *Cassia tora* L. and *Ruellia tuberosa* L. with their radicle and plumule were treated for 72 hours with different concentrations of 2, 4-D (acid). This herbicide inhibited the growth of seedlings of all these weeds effectively. The linear growth of the radicle and the hypocotyl was

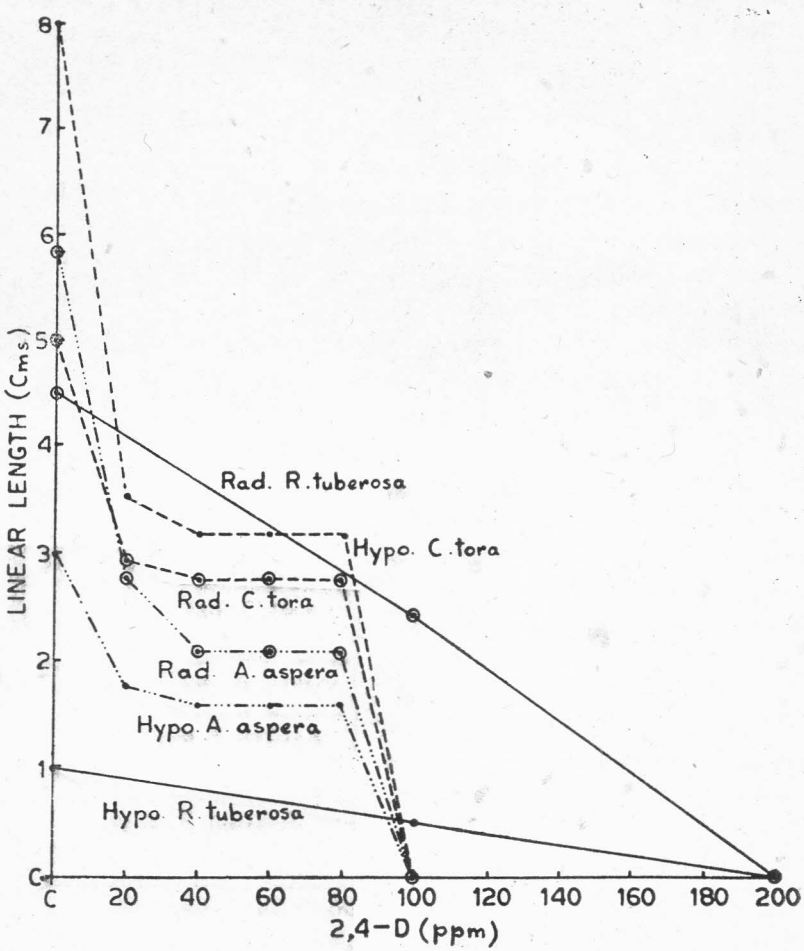

Fig. 1. Reduction in the linear length of the radicle and hypocotyl of the seedlings of *A. aspera*, *C. tora* and *R. tuberosa*.

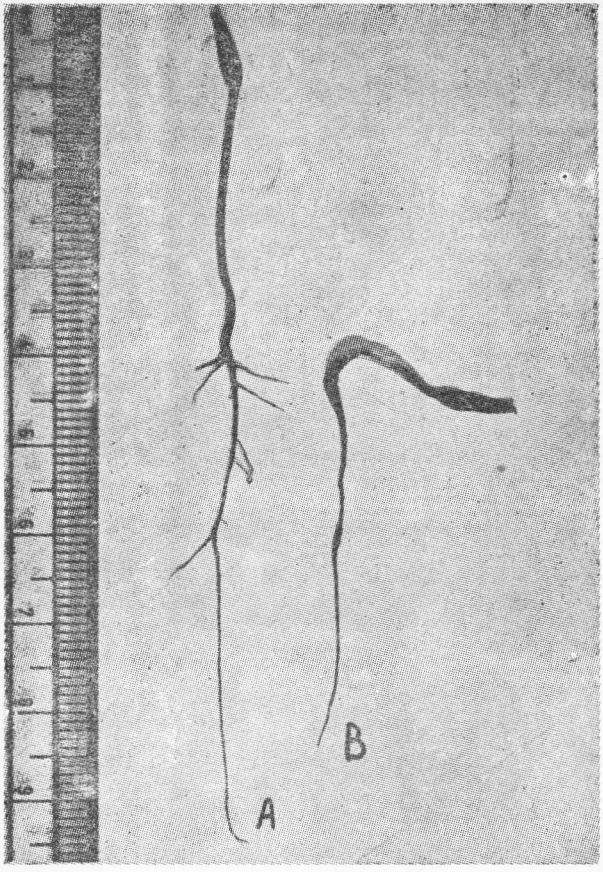

Fig. 2 Seedlings of *A. aspera* (A) Control. (B) showing swelling of the radicle at the point of original length at 80 ppm.

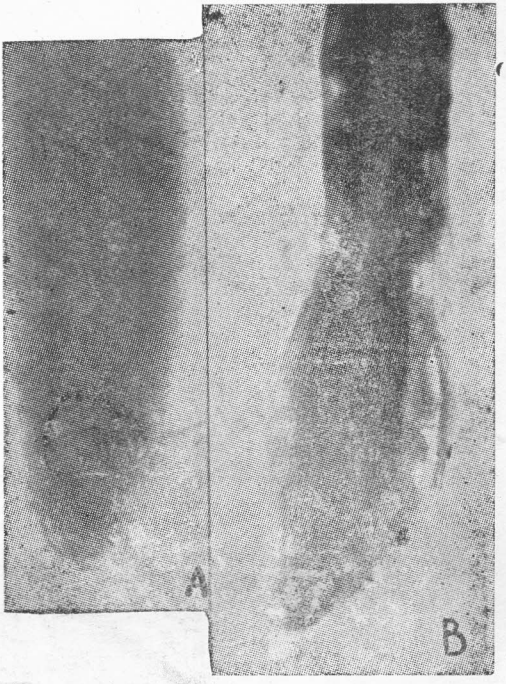

Fig. 3. Root tips of the seedlings of *A. aspera* (A) Control. (B) showing swollen root tip at 80 ppm.

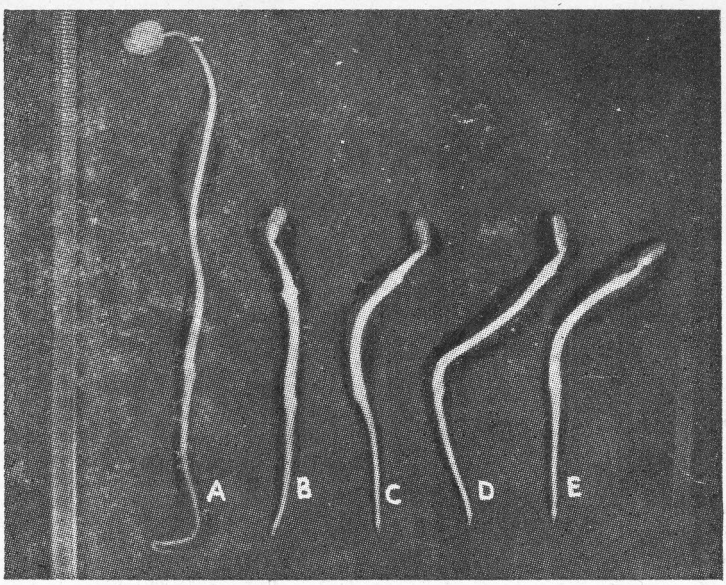

Fig. 4 Seedlings of *C. tora* (A) Control (B, C, D & E) showing the swelling of hypocotyl at 20-80 ppm.

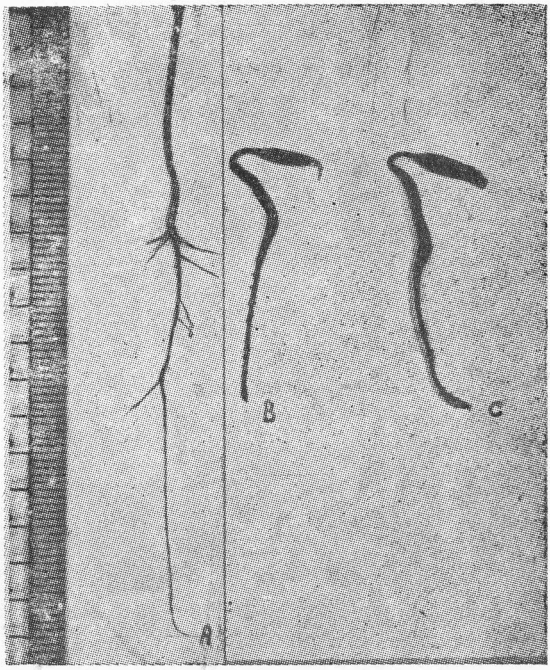

Fig 5 Seedlings of *A. aspera* (A) Control. (B & C) showing inhibited lateral roots at 80 ppm.

inhibited and growth of lateral roots was also checked. Rate of inhibition of radicle and hypocotyl increased at higher concentrations. It caused swellings of the radicle and the hypocotyl of *A. aspera* and *C. tora* seedlings. No such swellings were seen in *R. tuberosa*. The radicle of all the three species were more susceptible to 2, 4-D than the hypocotyl. 100 ppm was found lethal for *A. aspera* and *C. tora* and 200 ppm for *R. tuberosa* seedlings. The results were discussed with reference to the strength of the concentrations and their pH values.

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