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Ex-Situ phytotoxic effect of 2, 4-D on wheat and maize

ABDULLAH* and SHAFQAT ALAUDDIN[1]

Department of Botany, Shibli National P.G. College, Azamgarh - 276 001 (India)
[1]Department of Chemistry, Shibli National P.G. College, Azamgarh - 276 001 (India)

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ABSTRACT

Wheat and maize were selected to assess the phytotoxic effect of 2, 4-D. The entire experiments were divided into parts. In the first part Seed germination experiment was carried out, where as in the second part Pot culture experiment was done in which plants were grown into polythene bags in the soil and the parameters related to the growth and development were taken on 30th day. The effect of 2, 4-D on seed germination was very evident; as the concentration increased the germination percentage was decreased in both the plants. In the case of wheat, germination was 91% in control followed by 90% in 50 ppm, 87% in 100 ppm and 75% in 150 ppm solutions. For the same solution the germination percentage for the maize were 93, 87, 82 and 72 respectively. The effect of 2, 4-D on time of sprouting of seedling was very pronounced as concentration increased there was delay in the time of sprouting in both the plants. Mean root length and mean shoot length were decreased as concentration increased in the both the plants. The shootlets and rootlets were died on the 15th day in both plants even at 50 ppm solution. In pot culture experiment the leaf area and the number of leaves were decreased as the concentration increases. The photosynthetic pigments i.e. Chlorophyll *a* and Chlorophyll *b* were decreased as the concentration increased which indicates the phenomenon of chlorosis.

Key words: Phytotoxicity, 2, 4-D, Wheat, Maize.

INTRODUCTION

Among the various class of pesticides, herbicides are fastest growing which constitute 50-60% of total pesticides applied worldwide. The phenoxy compounds like 2, 4-D and 2, 4, 5-T are being widely used herbicides, to eradicate cropweeds. Wheat is most extensively grown crop in the Northern India, where as maize is also grown to a considerably large area. 2, 4-D is used against *Phalaris minor* and other broad leaved weeds.

The basic purpose of herbicide application was defeated after it has been found to be potentially toxic to non target organisms. Soon after the much acclaimed green revolution, the negative effect of herbicides has become visible. Besides its toxicity to animals and microorganisms, toxicity to crop plants is well documented. However, phytotoxic response varies with types and varieties of plants, its concentration, physico-chemical characteristics of soil such as moisture content, buffering capacity, cation exchange capacity (CEC), pH, organic matter and mineralogical compositions etc. The phytotoxic response often appears as delayed germination, stunted growth, depressed photosynthesis and ultimately defoliation (Edward *et al*., 1978).

MATERIALS AND METHODS

Wheat (var. UP-262) and maize (var. Jaunpuri Desi) were selected to assess the phytotoxic effect 2, 4-D due to its large scale cultivation of these varieties in eastern Uttar Pradesh. The entire experiment was divided into two parts .The part first was germination experiment and part second was pot culture experiment in which plants were grown in polythene bag and parameter related to growth and development were recorded.

In seed germination experiment 100 seeds of wheat and 20 seeds of maize were placed in a

pot having flat bottom with sand as suitable absorbent medium to provide equal status of solution and other conditions to all seeds. These seeds were treated with different concentration of 2, 4-D along with control at room temperature (25±5°C). Three replicates were maintained for each crop seeds and for each concentration. The time of appearance of first sign of germination was recorded for 10 seeds of each sample, and their mean value was calculated. The percentage germination, root length and shoot length of seeding (10 plants were taken from each sample) were recorded on 15th day after soaking the seeds. Seedling vigour index (SVI) was calculated by using the method of Abdul Baki and Anderson (1973).

In pot culture experiment 10 seeds of each are grown in polythene bag of equal size containing equal quantity of soil. These bags were irrigated on alternate days with different concentration of 2,4-D solution. A set of control was also maintained. Vegetative characteristics like shoot length, number of leaves, leaf area of largest leaf and chlorophyll content were measured on the 30th day after sowing. The leaf area was measured with the help of graph paper. Chlorophyll *a* and chlorophyll *b* were measured by the method of Smith and Benitz (1955), the summation of these two pigments were considered as total chlorophyll.

RESULT AND DISCUSSION

The result of seed germination experiment is summarised in table (1) and result of pot culture experiment is summarised in table (2).

In seed germination experiment all the parameters except time for sprouting is observed on 15th day. The effect of 2, 4-D on seed germination on both the plants i.e. wheat and maize were very evident. As the concentration increased the germination percentage decreased. In the case of wheat the germination was 91% in control followed by 90% in 50ppm, 87% in 100ppm and75% in 150 ppm solution. The germination percentages for the same concentration in maize were 93, 87, 82 and 72 respectively.

The delay in germination of seed is very pronounced as shown by the sprouting time. In the case of wheat, germination was noticed in 51 hrs for control followed by 67 hrs at 50 ppm, 69 hrs at 100 ppm and 72 hrs at 150 ppm solutions, while the values for maize were 53 hrs for control, 61 hrs for 50 ppm, 68 hrs for 100 ppm and 75 hrs for 150 ppm. The sprouting result for both plants indicates that as concentration increased there is increase in delay in the appearance of sprouting.

The shootlet length is adversely affected by 2, 4-D.The seedlings were shown to germinate initially but soon they became brownish and died. The wheat is found to be more sensitive than maize. In the case of wheat at concentration 100 ppm all the shootlets died away on 15th day where as in the case of maize they survived at 100ppm upto atleast 15th day.In both the cases even at lower concentration the shootlet growth is strongly retarded. The rootlets of both the plants were found to be more sensitive than shootlets. Even at 50 ppm in both the plants rootlets were died at the time of measurement i.e. on 15th day. The SVI (seedling vigour index) for shootlets and rootlets were insignificant due to death of rootlets and shootlets.

In pot culture experiment the plants growth in pot were observed on 30th day and data were recorded. In wheat mean shoot length in control was 14.5±2.5 cm followed by 12.3±2.7 cm, 8.1±2.1 cm, 4.0±1.5 cm at 50,100 and 150 ppm solution respectively, the same values for maize were 13.8±3.3,12.2±1.0,8.9±1.3 and 4.0±1.5 cm respectively. The shoot growth was retarded as concentration increased in both the plants.

The leaf area of the largest leaf was measured on 30th day, the leaf area in both the plants was found to be decreased at the increasing concentration. The numbers of leaves were also decrease in both the cases as the concentration increased. The chlorophyll *a*, chlorophyll *b* and total chlorophyll were decreased as the concentration increased which clearly indicates the phenomenon of chlorosis.

Thus from the above study it is clear that the deleterious effect of 2, 4-D on both the plants is very evident. However the tolerance limit is high in maize than wheat.

Table - 1: Seed germination result

S. No.	Plant Parameters	Wheat Concentration in ppm				Maize Concentration in ppm			
		Control	50	100	150	Control	50	100	150
1.	Seed Germination (%) 15th day	91	90	87	75	93	87	82	72
2.	Mean shoot let length (cm) ± SD, 15th day	6.71± 2.9	-	-	-	6.2 ± 2.1	-	-	-
3.	Mean shoot let length (cm) ± SD, 15th day	6.9 ± 2.7	1.1 ± 0	-	-	4.8 ± 1.4	3.3 ± 2.1	2.9 ± 2.5	-
4.	S.V.I for Shoot let	-	-	-	-	-	-	-	-
5.	S.V.I for Shoot let	-	-	-	-	-	-	-	-
6.	Time for sprouting (in hrs)	51	67	69	72	53	61	68	75

Table - 2: Seed germination result

S. No.	Plant Parameters	Wheat Concentration in ppm				Maize Concentration in ppm			
		Control	50	100	150	Control	50	100	150
1.	Mean Shoot length(cm) on 30^{th} day ± SD	14.5±2.5	12.3±2.7	8.1±2.1	4.0±1.5	13.8±3.3	12.2±1.0	8.9±1.3	4.0±1.5
2.	Leaf Area of Largest Leaf (cm^2) on 30^{th} day	38.8	29.9	21.0	14.1	45.9	39.0	22.2	18.4
3.	No. of Leaves on 30^{th} day	12	8	6	2	6	4	2	2
4.	Chlorophyll *a*(mg/l)	5.17	5.00	3.36	3.07	6.22	3.06	2.60	0.96
5.	Chlorophyll *b* (mg/l)	5.38	4.84	3.35	3.03	3.18	3.01	1.28	0.64
6.	Total Chlorophyll	10.55	9.84	6.71	6.10	9.40	6.07	3.88	1.60

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