EFFECT OF LEAD ON SEEDLING GROWTH OF TEST PLANT

Chapter-4

EFFECT OF LEAD ON SEEDLING GROWTH OF TEST PLANT

To study the effect of lead on seedling growth of test plant various concentrations of lead acetate were used for seedling growth studies of *Phaseolus mango* cv. T-9, T-16.

Two types of lead acetate treatements were given to the seeds of above cultivars. In the first type (Pretreatment), seeds were imbibed in various concentrations of lead acetate for their full imbibition period and there after transperred to disttiled water moistend filter paper in petridishes for seedling growth. In the second type (post radicle emergence treatment), seeds of test plant were imbibed in water for their full imbibition period. After the emergence of radicle (Visible not measurable) seeds were transferred to lead acetate solutions of various concentrations for seedling growth studies. In both the types of treatments. Seedling growth was studied in terms of length measurament at a suitable day i.e. 6 days after radicle emergence. Based on dose response curves for different test plant some suitable concentrations were selected for further seedling growth studies at 4th, 6th, 8th days after radicle emergence. For this seeds were pretreated in different concentrations of lead acetate. The result of different test plant have been disscussed (% control wise), at 50mg/l, lead acetate concentration generally. However when ever it is lethal results have been discribed for lower concentratons.

LEAD PRETRATMENT Vs SEEDLING GROWTH :

Uniformly selected seeds of *Phaseolus mungo* cv, T-9, T-16. were imbibed for 12 hours. In lead acetate solutiions of 10mg/l, 20mg/l, 30mg/l 40mg/l and 50mg/l lead acetate and in distilled water for control. Thereafter imbibed, seeds were thorouhly wased with water and transferred to disttiled water moistend filter paper in peridishes for seedling growth. At a suitable day (6th days after radcle emergence seedlings were dissected into parts and their lengths were measured.

It was reported that all the concentrations of lead acetate used were inhibitory to seedling growth but for a lower most concentration (10mg/l) which was nearly in effective, further with increasing concentrations there was greater decarese in the length of seedling parts. However maximum inhibition was seen in the highest concentration (50mg/l) treated sets .

POST RADICLE EMERGENCE TREATMENT :

In this type of treatment uniformely selected and sterlized seeds were soaked in distilled water for their full imbibition period. After the emergence of radicle seeds were treansferred to different concentrations of lead acetate solutions, 2×10^{-5} M, 5×10^{-5} M, 1×10^{-4} M, 2.5×10^{-4} M, 5×10^{-4} M, 1×10^{-3} M and 2×10^{-3} Pb in diffused light and dark respectively. At a suitable day (6th, 8th and 10th days of plating) seedlings were dissected into parts for seedling growth studies. Growth studies were done on Phaseolus, cultivars.

LEGUMES

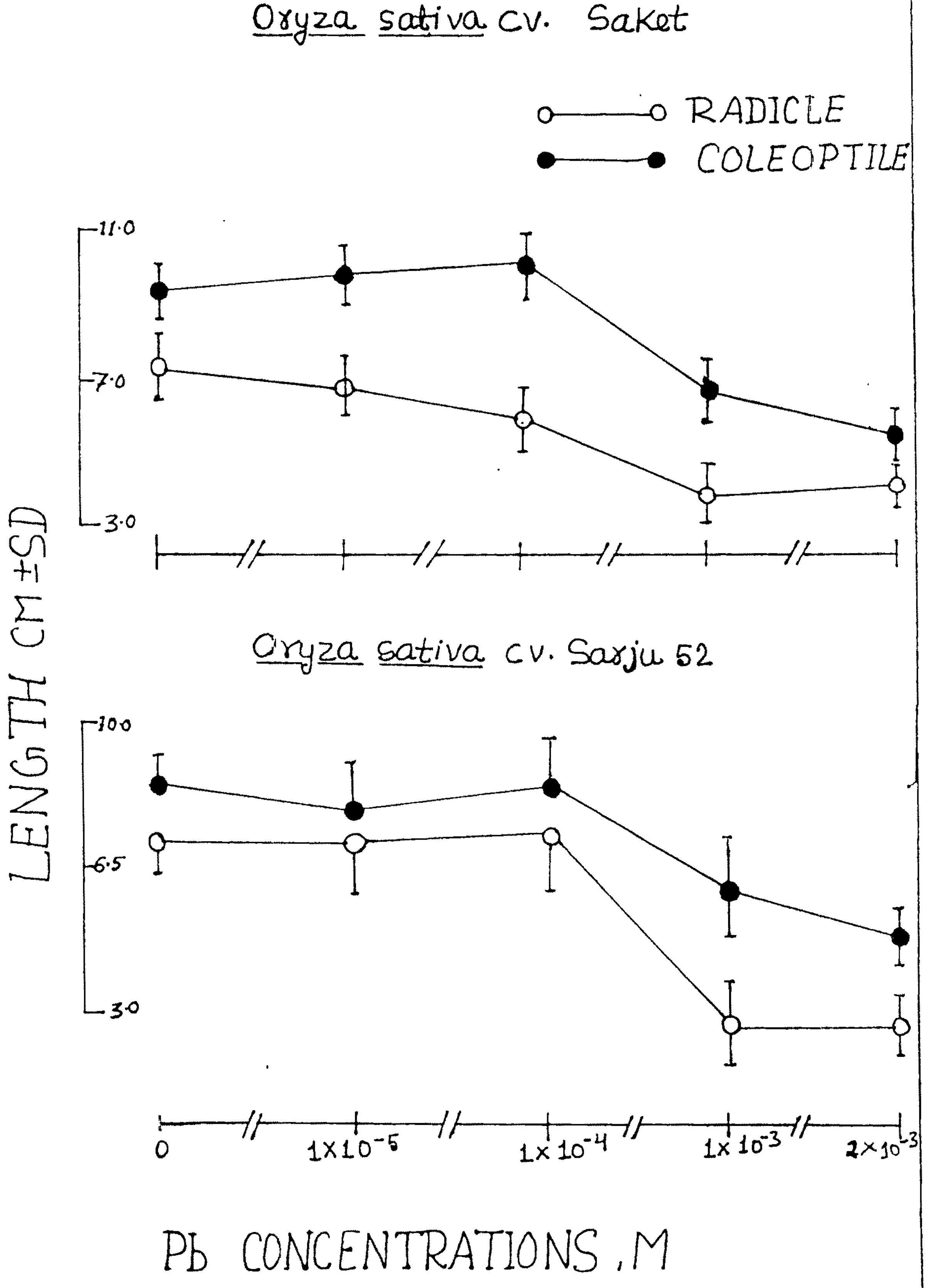
Seeds of *Phaseolus mungo* cv. T-9 and T-16 were imbibed for 12 hourse, while *Vigna radiata* cv. T-9, PS-7 and PS-16 for 24 hours and dose response relationships were studied as mentioned earlier.

Dose response curves of *Phaseolus mungo* cultivars are shown in fig. which indicate that with increasing concentration there is a decrease in the length of seedling parts, with maximum inhibition at the highest concentration.

At 2×10^{-3} M Pb concentration, there was no germination. Thus at 1×10^{-3} M Pb concentration in *Phaseolus mungo* cv, T-9 and T-16 the radicle length is Ca. 35% and 31% of control, hypocotyl length is Ca. 45% and 47% of control and epicotyl length is Ca. 56% and 40% of control respectively.

CEREALS In cereales dose response curves were studied on *Oryza sativa* cv. Saket and sarju 52 (As shown in fig.4). The

FIG-4 Pb PRETREATMENT vs LENGTH



radicle and coleoptile lengths of Oryza sativa cv. Saket, at 1×10^{-3} M Pb concentration are ca. 46% and 63% of control while of cv. Sarju 52 are ca. 43% and 67% of control respectively (as shown in fig.4).

Thus, in Oryza there is cultivar dependent differential response of the seedling parts. Far instancea redicle growth is most effected in cv. Sarju 52 and coleoptile growth in cv. Saket the above pretreatment studies show that species, cultivar specific and also, argon specific differences in response to Pb exist.

EFFECTS OF DARK GROWN SEEDLINGS

Dose response relafionship studied for Phaseolus mungo cvs. T-9 and T-16 (as shown in fig.6). In the cultivar T-9 at 5×10^{-5} M, 1×10^{-4} M, 2.5×10^{-4} M, 1×10^{-3} M and 2×10^{-3} M Pb concentrations, the length of radicle is ca. 105%, 90%, 71%, 26%, 23% and 0% (0% means radicle visible but not measurable) of control and of hypocotyl is ca. 97%, 94%, 71%, 44%, 29% and 0% of control while of epicotyl is ca. 85%, 76%, 64%, 57%, 58% and 0% of control respectively. So, with increasing the concentration, there is a decrease in the length of seedling parts, with maximum inhibition at 1×10^{-3} M Pb concentration, while 2×10^{-3} M Pb concentration is totally inhibitory for seedling growth. Same is the pattern with cv. PT-16 also except that, here 2×10^{-3} M Pb is not as much toxic for seedling as in case of cv. T-9. At 1×10^{-3} M Pb

FIG-5 Pb POST RADICLE EMERGENCE TREATMENT vs. LENGTH (LIGHT)

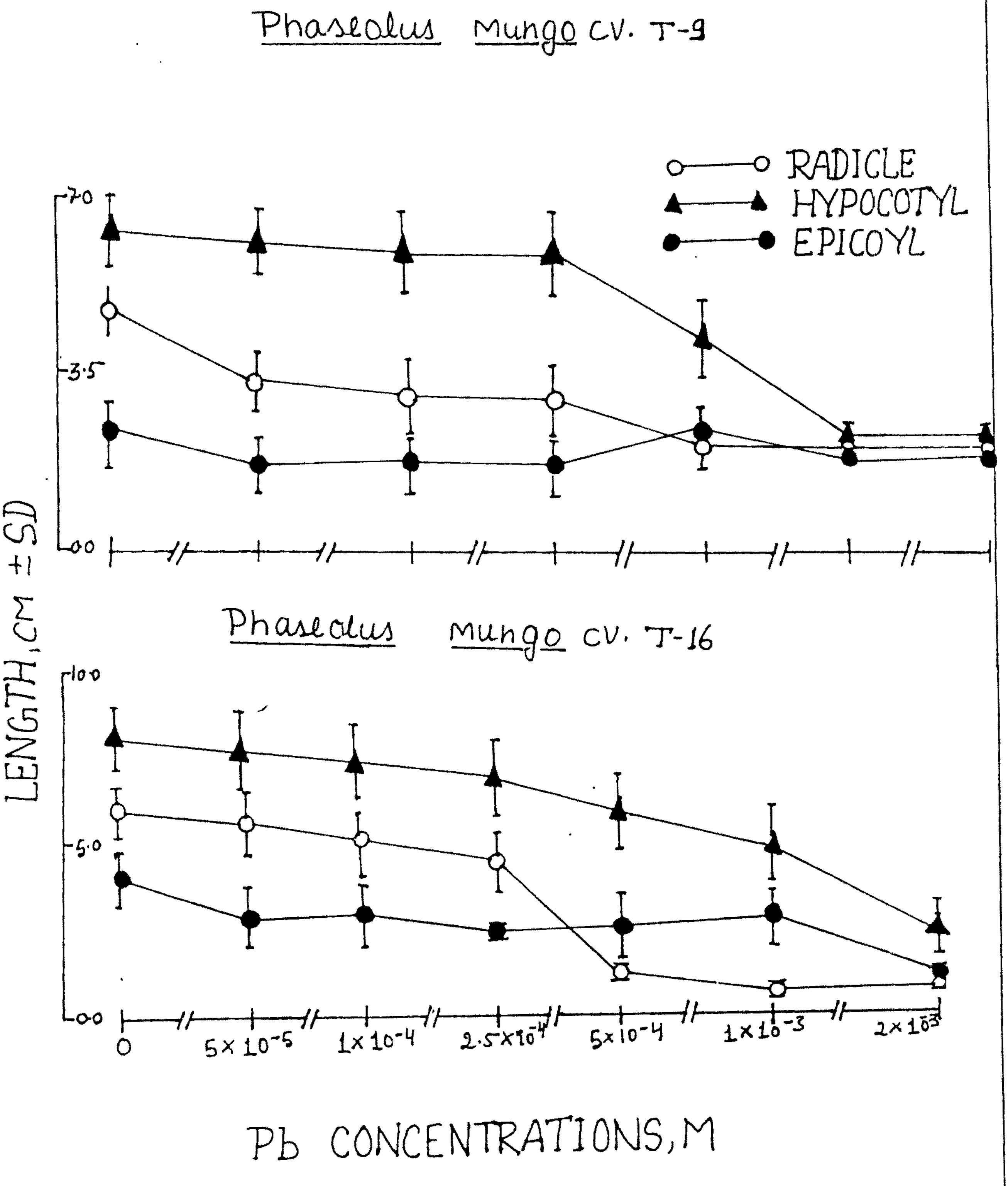
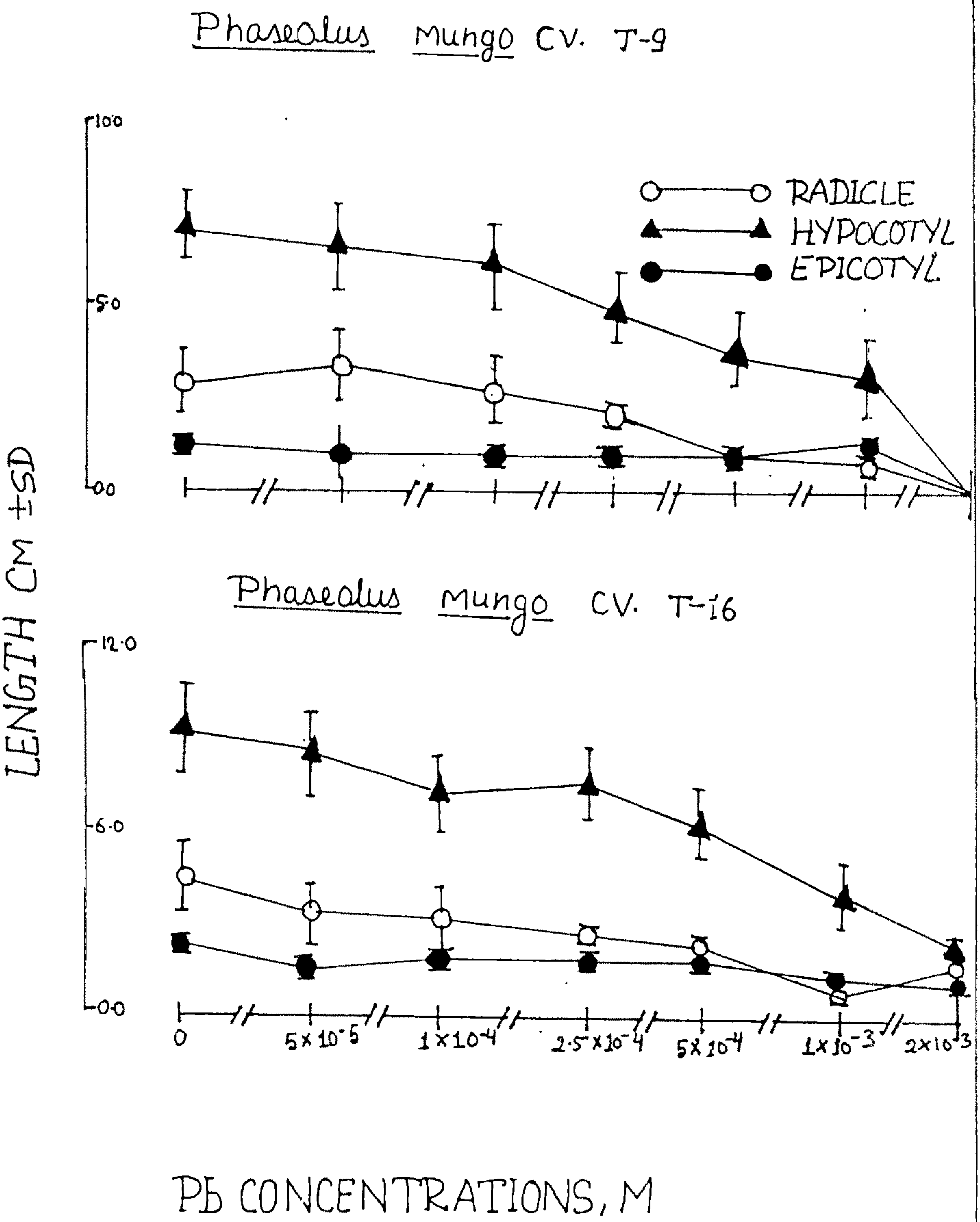


FIG-6 Pb POST RADICLE EMERGENCE TREATMENT vs LENGTH (DARK)



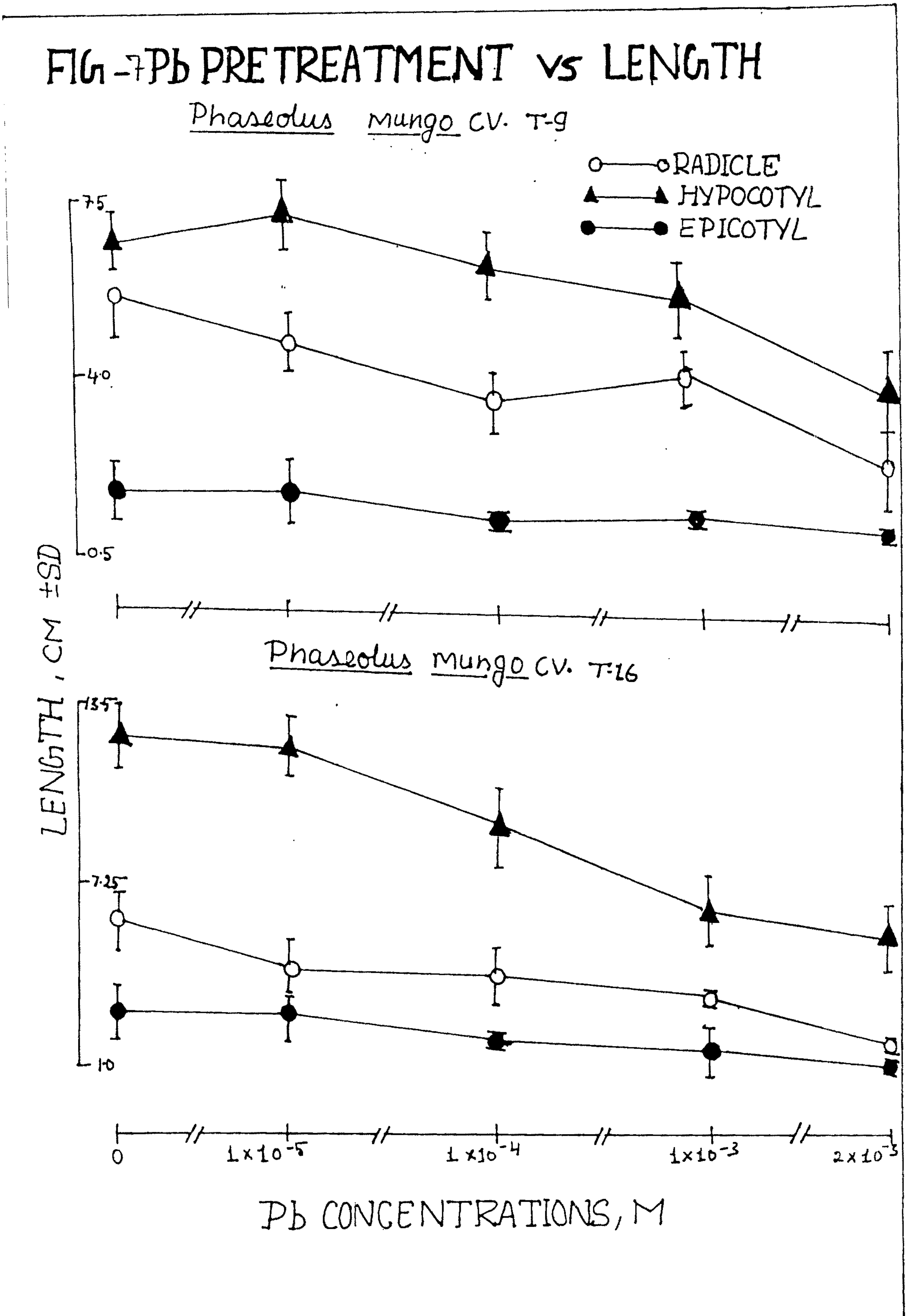


FIG-7 Pb PRETREATMENT vs LENGTH
Phaseolus mungo CV. T-9
RADICLE
HYPOCOTYL
EPICOTYL
7.5
4.0
0.5
LENGTH, CM ±SD
Phaseolus mungo CV. T-16
13.5
7.25
1.0
0
1×10⁻⁵
1×10⁻⁴
1×10⁻³
2×10⁻³
Pb CONCENTRATIONS, M

concentration, in cvs. 23% and 22% of control, of hypocotyl are ca. 29% and 31% of control and of epicotyl are ca. 58% and 60% of control respectively.

EFFECTS ON LIGHT GROWN SEEDLINGS

The investigations were carried on Phaseolus mungo cv. T-9 and cv. T-16 as shown in fig.5 In former, at 5×10^{-5} M, 1×10^{-4} M, 2.5×10^{-4} M, 5×10^{-4} M, 1×10^{-3} M, and 2×10^{-3} M, Pb concentrations, the radicle length is ca. 81%, 76%, 73%, 35%, 25% and 21% of control, hypocotyl length is ca. 99%, 94%, 91%, 58%, 20% and 18% of control and epicotyl length is ca. 97%, 99%, 97%, 82%, 39%, and 33% of control respectively. So, with increasing the concentration there is a decrease inthe length of seedling parts, with maximum inhibition at the highest concetration in both cv. i.e. T-9 and T-16 at 1×10^{-3} M Pb concentration the length of radicle is ca. 25% and 15% of control and of epicotyl is ca. 20% and 53% of control while of hypocotyl is ca. 39% and 54% of control respectively.

SEEDLING GROWTH UNDER THE INFLUENCE OF VARIOUS CONCENTRATIONS OF LEAD AMENDED SOIL

To investigate the influence of various concentration of lead amended soil on seedling grwoth, Vigna radiata cultivars were studied. For the study, experimental plot, which was sandy, clayey loam type, rich in organic nutrients and had acidic pH. The soil was amended with lead sulphate so as to make final concentrations of lead 10mg/kg soil and 50mg/kg soil. Selected seeds of Vigna radiata cv. T-9 and PS-16 were imbited in distilled water for twenty four hours (whole imbibition period), thereafter, sown separately in blank (without lead) soil i.e. control, lead 10 mg/kg soil and 50mg/kg soil, which were kept in small polythene bags and kept in dark for germination. Control and experimental sets were irrigated by tubewell water. There were 20 bags for each set and in each bag 20 seeds were allowed to germinate. The experiments were performed in laboratory conditions after 3, 5 and 7 days of sowing seedling were carefully removed from the soil for seedling growth studies.

For seedling growth analysis, samples were taken at 3rd, 5th and 7th day after sowing.

The dose response curve was determined with cv. T-9, which shows that in Vigna radiata 10mg/kg soil lead concentration promotes and thereafter there is inhibition. The effects of two concentrations used are described below.

The results of the effects of lead on seed germination, seedling growth in terms of length and fresh weight, in various seedling parts of Vigna radiata cv. T-9, PS-7, PS-16 are given in tabel. 12, 13, 14.

Table indicates the effects of 10mg/kg and 50mg/kg lead concentrations on seed germination and seedling growth, both in terms of length and fresh weight of radicle and epicotyl of *Vigna radiata* cv. In general, there is a marked promotion in germination at the lower concentration and inhibition of the same at the higher concentration of lead as compared the varietal differences are well marked in response to cintrols for all the days of study and in all the cultivars studies. As for as the germination is concerned to lead. At 10mg/kg lead concentration germination is promoted to 100% in all the cases but extents of inhibition differ with the cultivar. Maximum inhibition is in cv. PS-7, being ca. 17% lesser than control and minimum is in cv. T-9 being only 6% lower than control, cv. PS-16 comes in between, the value is ca. 11% lower than control. Thus, on the basis of germination percentage cv. T-9 seems to be more resistant and cv. PS-7 more susceptible for lead than other cultivars.

Table 42 show that like seed germination, seedling growth is also promoted at 10mg/l and inhibited at 50mg/l lead concentraation in all the three cultivars studied. Organ specific and cultivar differences are well marked. At 10mg/l lead concentration, the grwoth of epicotyl is more promoted as compared to the growth of radicle, both in terms of length and fresh weight, in all the cultivars. Thus, on the 3rd day of germination, the lengths of epicotyl and radicle are promoted by ca. 40% and 36% over control respectively, in cv. T-9 ca. 55% and 53% over controls respectively, in cv. PS-7 and ca. 46% and 41% over control respectively, in cv. PS-16. The fresh weights of epicotyl and radicle, at the same day of germination, are promoted ca. 46% and 41% over control respectively, in cv. T-9 ca. 87% and 55% over control respectively, in cv. PS-7 ca. 73% and 45% over control respectively in cv. PS-16. Same pattern of promotion persists on 5th and 7th day of germination. As difference in the varietal response for lead is concerned, promotion is much more in cv. PS-7 as compared to cvs. T-9 and PS-16. At 50mg/l lead concentration, the growth of epicotyl is more inhibited as compared to the growth of radicle, both, in terms of length and freash weight, in all the cultivars. Thus, at the 3rd day of germination, the length of epicotyl and redicle are inhibited ca. 20% and 16% as compared to controls respectively, in cv. T-9 ca. 30% and 27% as compare to controls respectively, in cv. PS-7 and ca. 27% and 21% as compared to controls respectively in cv. PS-16. The fresh weights of epicotyl and radicle, at the same day are inhibited, ca. 18% and 14% as compared to control respectively, in cv. T-9, ca. 38% and 25% as compared to control respectively, in cv. PS-16 same results have been observed at 5th and 7th day of germination. As for the difference in varietal response to lead is concerned, inhibition is much more in cv. PS-7 in comparision to other two cultivars. Observations also reveal that the extents of promotion and inhibition slightly decrease with a the age of seedlings. It means that the recovery induced by lead is very slow. On the basis of seedling growth studies, it appears that cv. T-9 is more

Table - 12

Effect of Lead amended soil to seeds on germination and growth in dark grown seedling of *Vigna radiata* cv. T-9.

Parameter / Organ.	Days after radicle emergence								
	3			5			7		
	Lead concentration, mg l^{-1}								
	0	10	50	0	10	50	0	10	50
Germination %	92.00	100.00	86.50	-	-	-	-	-	-
Length, cm ± SD									
Radicle	1.10	**1.50	**0.92	2.10	**2.71	**1.33	2.80	**4.56	**3.02
	±0.18	±0.52	±0.12	±0.20	±0.45	±0.15	±0.25	±0.50	±0.20
Epicotyl	1.25	**1.75	1.00	2.21	**4.10	*1.88	4.00	**6.38	*3.65
	±0.17	±0.50	±0.20	±0.32	±0.61	±0.23	±0.40	±0.50	±0.35
Fresh weight mg ± SD									
Radicle	33.10	**43.36	**28.30	61.50	**81.20	**55.80	100.80	**120.60	**95.60
	±2.30	±3.27	±1.50	±2.55	±4.16	±1.82	±2.83	±5.35	±2.00
Epicotyl	17.50	**25.55	**14.30	33.80	**40.50	**30.50	81.20	**88.90	**75.52
	±1.05	±1.87	±1.32	±1.25	±2.05	±1.50	±1.70	±2.38	±1.84

* Significant at 5% level, ** Significant at 1% level, Sample number (n) = 20

0 = Blank soil(control) , 10 = Ni 10 mg/kg soil , 50= Ni 50 mg/kg soil.

Table - 13

Effect of Lead amended soil to seeds on germination and growth in dark grown seedling of *Vigna radiata* cv. PS-7

Parameter/ Organ	Days after radicle emergence								
	3			5			7		
	Lead concentration, mg l^{-1}								
	0	10	50	0	10	50	0	10	50
Germination %	85.15	100.00	70.81	-	-	-	-	-	-
Length, cm ± SD									
Radicle	2.75	4.20**	2.01**	6.52	9.52**	4.42**	10.52	14.03**	7.68**
	±0.50	±0.60	±0.35	±0.65	±0.47	±0.43	±0.60	±0.60	±0.65
Epicotyl	0.67	1.04**	0.47*	2.00	2.70**	1.74*	4.89	6.24**	4.00*
	±0.20	±0.25	±0.15	±0.30	±0.34	±0.26	±0.38	±0.40	±0.30
Fresh weight, mg ± SD									
Radicle	33.20	51.40**	24.90**	63.20	92.91**	53.09**	111.40	146.50**	91.26**
	±2.00	±3.00	±2.05	±2.08	±4.50	±2.15	±2.50	±5.00	±2.25
Epicotyl	10.80	20.20**	6.70**	44.20	58.60**	31.40**	103.50	133.30**	74.70**
	±1.00	±2.50	±1.25	±3.00	±1.50	±1.50	±1.50	±3.50	±1.75

* Significant at 5% level, ** Significant at 1% level, Sample number (n) = 20

0 = Blank soil (control), 10 = Ni 10 mg/kg soil , 50 = Ni 50 mg/kg soil.

Table - 14

Effect of Lead amended soil to seeds on germination and growth in dark grown seedling of *Vigna radiata* cv. PS-16

Parameter/ Organ	Days after radicle emergence								
	3			5			7		
	Lead concentration, mg l^{-1}								
	0	10	50	0	10	50	0	10	50
Germination %	88.88	100.00	78.75	-	-	-	--	-	-
Length, cm± SD									
Radicle	1.24	1.75**	0.98**	2.34	3.51**	1.57**	3.37	4.51**	2.51**
	±0.25	±0.45	±0.20	±0.38	±0.85	±0.30	±0.31	±1.00	±0.45
Epicotyl	1.05	1.55	0.77*	1.00	2.57**	1.08*	2.03	2.60*	1.54*
	±0.20	±0.40	±0.20	±0.40	±0.50	±0.35	±0.50	±0.60	±0.50
Fresh weight mg± SD									
Radicle	20.10	25.15*	16.48**	34.00	54.90**	28.80**	43.70	61.30**	31.40**
	±1.80	±2.57	±1.50	±2.05	±3.87	±1.75	±3.75	±4.00	±2.80
Epicotyl	18.60	32.20**	13.58	34.10	53.88**	29.67**	63.50	74.00**	44.41**
	±0.85	±1.00	±0.65	±1.09	±5.00	±1.85	±1.50	±6.00	±2.05

** Significant at 1% level, * Significant at 5% level, Sample number(n)=20

0 = Blank soil (control), 10= Ni 10 mg/kg soil, 50 = Ni 50 mg/kg soil.

Table - 15

Effects of presoaking of *Vigna radiata* cv. T-9 seeds in different concentrations of Lead on seedling growth in dark at different days after radicle emergence.

Seedling Parts	Days from emergence	Lead concentrations, M: Control	$1x10^{-5}$	$1x10^{-4}$	$1x10^{-3}$	$2x10^{-3}$
		Dry weight, mg ± SD				
Epicotyl	3	1.40±0.28	1.35±0.10	1.30±0.14*	0.45±0.11**	0.65±0.08**
	5	3.53±0.60	3.55±0.82	2.87±0.40**	2.10±0.37**	1.68±0.45**
	7	6.63±0.80	6.64±1.67	6.39±0.89	5.68±0.80**	2.01±0.42**
Hypocotyl	3	10.87±1.03	10.80±2.57	9.91±1.37	3.20±0.86**	1.28±0.27**
	5	16.24±1.50	16.12±3.04	14.33±1.37**	9.38±1.02**	4.00±0.82**
	7	17.03±1.00	16.39±1.39	15.32±2.58**	9.97±1.03	5.07±0.72**
Radicle	3	1.18±0.21	1.28±0.29	1.14±0.60	0.17±0.00	0.10±0.00**
	5	4.50±0.52	2.58±0.50**	2.01±0.60**	0.75±0.20**	0.53±0.24**
	7	4.60±0.85	4.68±1.13	4.07±0.89	1.53±0.17**	0.90±0.11**
Cotyledon	3	24.03±3.27	22.32±1.39	24.35±3.23	33.67±4.67**	35.32±4.83**
	5	8.39±1.37	8.37±0.96	13.57±1.23**	19.23±1.67**	24.37±3.23**
	7	1.05±0.00	1.37±0.07**	4.78±0.62**	12.18±1.87**	21.86±2.38**

* Significant at 5% level.

** Significant at 1% level.

Table - 16

Effects of presoaking of _Vigna radiata_ cv. PS-7 seeds in different concentrations of Lead on seedling growth in dark at different days after radicle emergence.

Seedling Parts	Days from emergence	Lead concentrations, M				
		Control	$1x10^{-5}$	$1x10^{-4}$	$1x10^{-3}$	$2x10^{-3}$
		Length, cm ± SD				
Epicotyl	3	1.31±0.30	1.35±0.10	1.25±0.15	** 0.71±0.12	** 0.63±0.07
	5	4.42+0.54	4.41+0.66	* 3.92+0.39	** 2.04+0.47	** 1.40+0.28
	7	15.85±2.43	15.91±2.44	15.45±1.60	** 10.27±1.37	** 1.87±0.27
Hypocotyl	3	4.33±0.45	4.75±0.54	4.35±0.40	** 1.36 ±0.41	** 0.50±0.14
	5	12.27±1.46	12.48±1.38	11.33±1.03 *	** 6.32±1.00	** 2.60±0.24
	7	13.16±1.40	12.86±1.86	11.89±0.80	** 7.87±0.84	** 3.24±0.32
Radicle	3	3.44±0.43	3.74±0.43	3.32±0.42	0.48±0.12	** 0.33±0.12
	5	9.11±1.26	** 7.84±1.38	** 6.61±1.01	** 2.33±0.44	** 1.63±0.36
	7	11.00+1.11	11.71+1.82	** 9.12+1.24	** 3.56+0.33	** 2.23+0.37

* Significant at 5% level.

** Significant at 1% level.

Table - 17

Effects of presoaking of *Vigna radiata* cv. PS-16 seeds in different concentrations of Lead on seedling growth in dark at different days after radicle emergence.

Seedling parts	Days from emergence	Lead concentrations, M				
		Control	1×10^{-5}	1×10^{-4}	1×10^{-3}	2×10^{-3}
		Length, cm ± SD				
Epicotyl	3	1.24±0.28	1.24±0.20	1.18±0.21	0.92±0.15**	0.58±0.08**
	5	33.38±0.86	3.84±0.59	3.23±0.58	1.80±0.28**	0.91±0.14**
	7	16.74±1.53	15.29±2.05	13.65±1.32**	9.10±0.40**	3.66±0.30**
Hypocotyl	3	4.00±0.37	4.21±0.61	3.85±0.35	2.11±0.46**	0.74±0.11**
	5	12.70±0.81	12.65±0.80	12.35±0.80	4.36±0.67**	2.85±0.35**
	7	13.97±0.77	13.02±1.08	12.18±1.40	6.75±1.04**	2.90±0.86**
Radicle	3	4.30±0.58	4.31±0.89	4.01±0.88	1.44±0.35**	0.58±0.11**
	5	7.99±0.57	7.38±0.60	7.01±0.87	2.64±0.40**	1.78±0.14**
	7	10.80±2.16	10.10±1.78	10.24±1.37	3.57±0.66**	2.42±0.12**

** Significant at 1% level.

resistant and cv. PS-7 is comparatively more sensitive for lead concentrations.

Table and indicate a consistent rise in dry weight of radicle and epicotyl with the age of dark grown seedlings, both, in control and experimental sets, but the total dry weight of seedling parts i.e. of radicle, epicotyl and cotyledon pair slightly decrease with the age of seedlings. The rise in the dry weight of radicle and epicotyl is paralleled by the decline in the dry weight of residual cotyledons. The dry weight of radicle and epicotyl at the lower concentrations. The dry weight of radicle and epicotyl at the lower concentration increases, while, at the higher concentration of lead decreases, paralleled by reciprocal extents of decline in the dry weight of residual cotyledons as compared to controls. Patterns of such dry matter transfer is similar in control and experimetnal sets. however, extents vary.