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MORPHOLOGICAL & PRODUCTIVITY RESPONSE OF *Abelmoschus esculentus* (OKRA) UNDER THE STRESS OF LEAD NITRATE

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ABSTRACT

The experiment was conducted to evaluate the morphological & productivity response on *Abelmoschus esculentus* under the stress of lead nitrate. The seeds of *Abelmoschus esculentus* were treated with 0.1%, 0.2%, 0.3%, 0.4% & 0.5% treatment concentration of lead nitrate before sowing in the experimental plot and the resulting plants were considered as M_1 generation. The seed obtained from M_1 generation under different treatment were again treated with the corresponding concentration of lead nitrate & the obtained crop is designated as M_2 generation. The result showed a decreasing trend in the seed germination, seedling survival, height of native plant, number of pod formation and weight of 100 seeds with increase in the treatment concentration however there is no significant effect of lead nitrate on emergence of branches. The average height of survived plants increased upto 0.2% treatment concentration of lead nitrate in comparison to control thereafter, with increasing the treatment concentration, the average height decreased. Besides average height of the plants, results showed increasing deleterious effect with increasing the treatment concentration of lead nitrate in respect to germination percentage, survival of seedlings, number of pods per plants and weight of seeds in both M_1 & M_2 generation. The deleterious effect is maximum in 0.5% treatment concentration. Thus considering all the parameters taken for study, it clearly showed negative impact on overall growth, morphological features and ultimately productivity of *Abelmoschus esculentus* in comparision to control. The deleterious effect increases with increasing the treatment concentration of lead nitrate.

KEYWORDS : Lead nitrate, *Abelmoschus esculentus*, Morphology, Productivity

Vegetables play a major role in Indian agriculture by providing food, nutritional and economic security and more importantly producing higher return per unit area and time. Most of the vegetables, being short duration crops, fit very well in the intensive cropping system and are capable of giving very high yield and very high economic returns to the grower. According to Ganry J., 2005 in Asia, the production and availability of vegetables is higher as compared to other continents. India is known as fruit and vegetables basket of the world. It ranks second in fruits and vegetables production in the world after China. As per National Horticulture Database, during 2010-11, India produced 74.878 million metric tonnes of fruits and 146.554 million metric tonnes of vegetables. The area under cultivation of fruits stood at 6.383 million hectares while vegetables were cultivated at 8.495million hectares.

Okra is one of the most popular, tasty and gelatinous vegetable and it play a vital role in human diet. It contains protein, carbohydrates and vitamin C. It also has anti-oxidant and anti-diabetic properties. Several workers have reported that okra has found medical application as a plasma replacement or blood volume expander (Lengsfeld et al., 2004, Adetuyi et al., 2008, Kumar et al., 2010). Seeds of okra are also a source of oil.

Okra is susceptible to many pathogens. Many fungicide and insecticides are used to control them. Use of Agricultural fertilizers, herbicides, insecticides and pesticides and migration of contaminants into a non contaminated land as vapours and leach ate through soil, or as dust, or spreading of sewage sludge contributes towards contamination of the ecosystem. A wide range of materials which cause contamination includes heavy metals, inorganic and organic compounds, oils and tars, toxic and explosive gases, combustible and putrescible substances, hazardous wastes and explosives. These chemical compound have adverse impact on seed germination, height of plants, number of branches, time taken for flowering, number of pods per plant, weight of seeds, period of harvesting etc.

Metals have the special attention with respect to their toxicological effect on human health, plants and animals. Lead is one of the highly dispersed metals by the human activities. Lead is widely used in industry and consumer product like batteries, pigments, metal coatings plastics etc.

Lasat, 2002 reported that the metals most damaging to crops are Cd, Cu, Mo, Ni, Pb and Zn. Many workers have been reported the inhibition of seed germination by heavy metals (Brown and Wilkins, 1986; Morzekand Funiceli, 1982; Shafiq and Iqbal, 2005).

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Muhammad, Shafique et al., 2008 reported the effect of lead and cadmium on the germination and seedling growth of *Leucaena leucocephala* and its tolerance.

Pandit and Prasanna, 1999 reported reduction of germination and inhibition of root and body development on *Sorghum bicolour* L. exposed to different concentration of cadmium.

Chandra Shekar et al., 2011 reported that lower concentration of Cd treatment showed enhanced percentage of germination, survival percentage, plant height, root length, early flowering, more pollen viability, increase in total chlorophyll content but the higher concentration of cadmium treatments showed inhibitory effect in *Lycopersicom esculentus* Mill.

Vijaya ragavan et al., 2007 determined the inhibitory effects of some heavy metals ($CdCl_2$, $CuSO_4$, $PbCl_2$, $HgCl_2$) on *Miscanthus* species. The same pattern of response was noticed in the case of *Raphanus sativus* L. due to cadmium treatment.

Buts et. al., 2011 reported that lead nitrate treatment showed decrease in percentage of germination, survival percentage, plant's height and pod formation.

The present study was under taken to evaluate the effect of lead nitrate on growth and development of okra (*Abelmoschus esculentus*) during their whole life cycle in field condition upto two generation. Parameters taken for study are seed germination, plant's height, number of branches, time taken for initiation of flowering, number of pods per plants, period of harvesting & weight of seeds in M_1 & M_2 generations.

MATERIALS AND METHODS

Okra is an important member of the family Malvaceae with 2n=8x=72 to 144 chromosomes and is polyploid in nature. The seeds of *Abelmoschus esculentus* were purchased from Saac Sabji Anusandhan Kendra, Kanpur. Healthy seeds of equal size & shape were selected for treatment with lead nitrate . lead nitrate is the white or colourless translucent crystals, d -4.53, poisonous ,one g. dissolve in 2 ml Cold water, in 0.75 ml. boiling water, in 2500 ml. absolute alcohol, in 75 ml. absolute methanol, insoluble in concentrate HNO_3. The aqueous solution is slightly acidic. Before sowing of seeds in the experimental plots, seeds were soaked overnight in distilled water. Then soaked 100 seeds were placed in each petridishes containing concentration of 0.1%, 0.2%, 0.3%, 0.4%, & 0.5% of lead nitrate for 6 hours in the laboratory and after treatment these seeds were allowed to germinate in petri-dishes lined with filter paper and cotton wools. After radicle emergence, they were sown in experimental field under controlled conditions. 100 seeds soaked in distilled water for overnight were sown in experimental field as control. The seeds were shown in lines keeping a distance between rows is 75-80 cm. Rows in east-west direction that will best capture the sunlight. Distance between rows will provide space for ease in movement during spraying, side dressing and harvesting. On the contrary, in the field, the emergence of hypocotyls and cotyledons above the surface of the soil had been taken as an index of germination. Arrangement was made for regular operation and irrigation. Neither chemical nor other fertilizers were used. This was done to avoid confusion. In the field, seeds were shown in the first week of July and final harvesting was done during the period of November. In between the above periods morphological characters were studied with respect to plant height, date of first flowering, number of pods per plants etc.

The seeds were collected after harvesting and stored in glass containers separately with specific symbols & considered as M_1 generation. Weight of hundred seeds was taken separately obtained from control as well as treated plants and seed quality was also observed. The stored seeds of M_1 generation were again treated with the corresponding concentration i.e. 0.1%, 0.2 %, 0.3 %, 0.4% and 0.5% of chemical taken for study by the same methods as mentioned above for M_1 generation and sown in the prepared field. Now this second generation was considered as M_2 generation. The morphological as well as reproductive characters were observed like M_1 generation. The phenotypic variability and their frequencies were collected & finally the rate of induced variability of quantitative characters in M_1 and M_2 generations were calculated.

RESULTS AND DISCUSSION

The results obtained in the present study have been shown in table 1 & 2 and figure 1. (A-E) and expressed together with the discussion in separate heading as under:-

Effect of Lead Nitrate on seed germination

In M_1 generation, the average seed germination of Azad bhindi-1 are 88%, 82%, 78%, 72% & 72% in 0.1%, 0.2%, 0.3%, 0.4% & 0.5% treatment concentration respectively in comparison to 90% under control.

In M_2 generation, the average seed germination of Azad bhindi-1 are 86%, 82%, 80%, 80% & 70% in 0.1%, 0.2%, 0.3%, 0.4% & 0.5% concentration of lead nitrate respectively in comparison to 100% under control.

Therefore, the data showed that Lead nitrate adversely affect the seed germination in both generations of Azad bhindi-1. The reduction in seed germination is gradual as per increase in concentration of lead nitrate. Seed germination was inversely related to the treatment

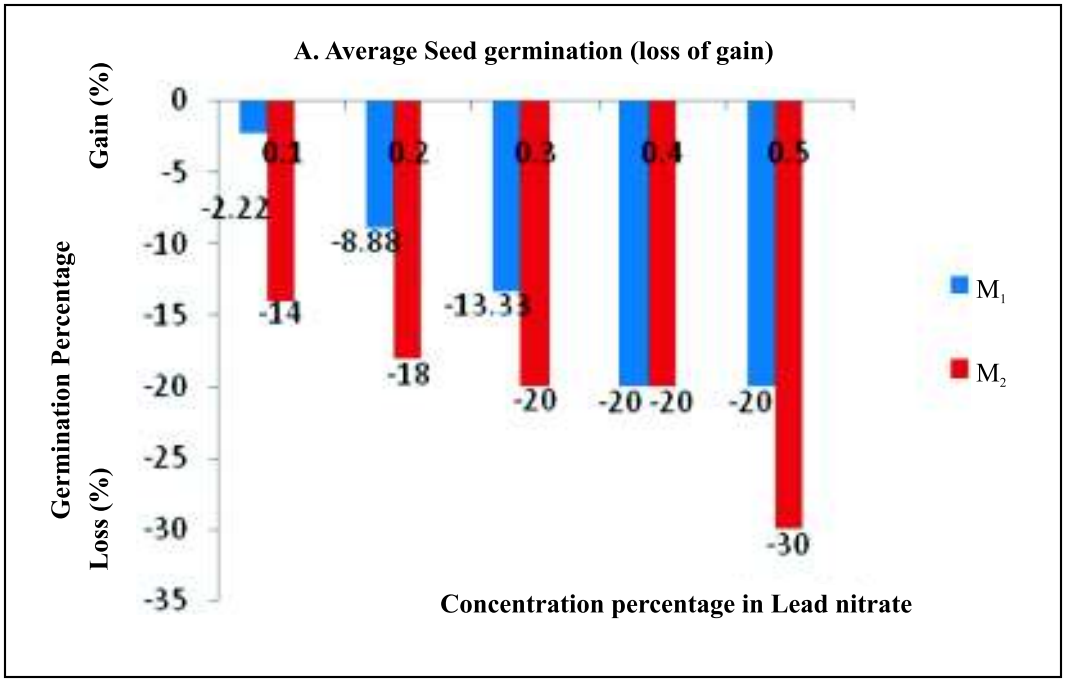
Table 1: Quantitative characters of *Abelmoschus esculentus* under the stress of lead nitrate

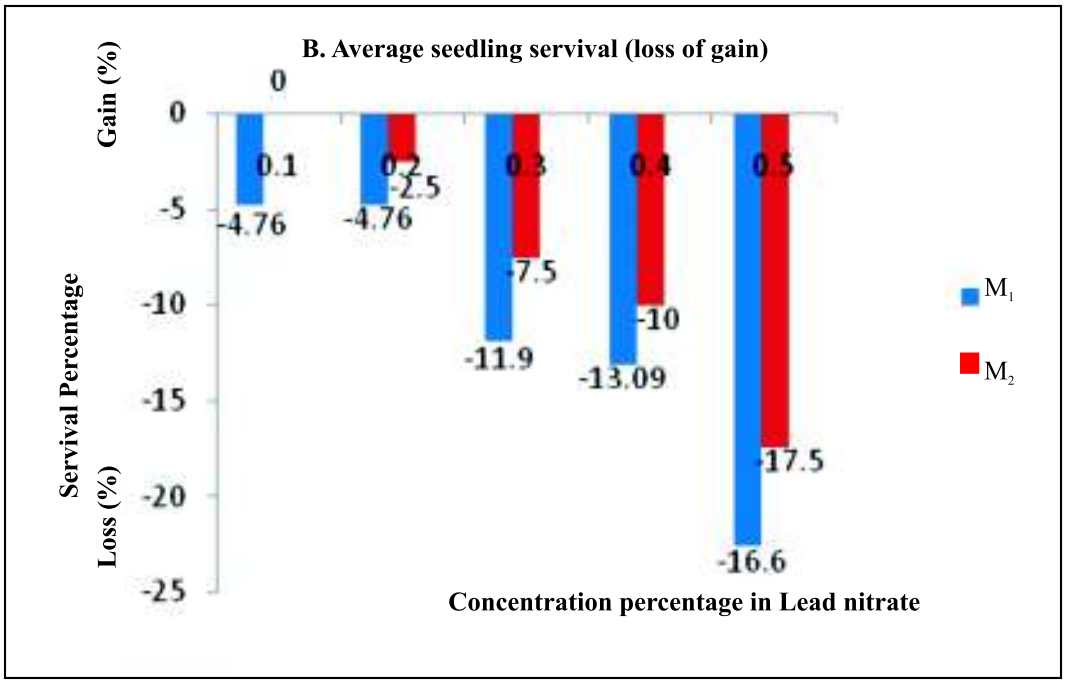
M_1 GENERATION

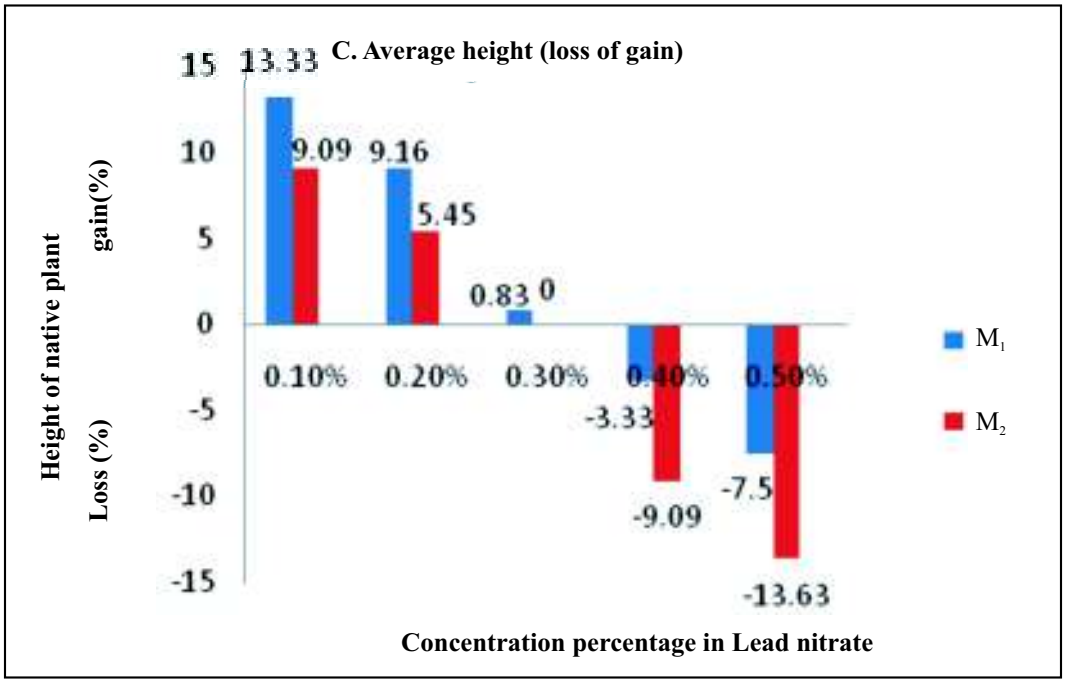
Treatment Lead nitrate	Germination (%) in field	Seedling survival(%) in field	Height of native plants(m) (±S.D.)	No.of branches per plant	Days taking 1 st flowering	Period of harvesting	No.of pod per plants (±S.D.)	Weight of 100 seeds(gram) (±S.D.)
Control	90	84	1.2 ±0.16	Nil	48-55	56-113	18.1 ±3.36	5.384 ±0.09257
0.1%	88	80	1.36 ±0.21	Nil	48-55	56-113	15.3 ±2.21	5.143 ±0.25923
0.2%	82	80	1.31 ±0.30	NIL	48-55	56-113	14.53 ±2.81	5.309 ±0.1623
0.3%	78	74	1.21 ±0.31	Nil	48-55	56-113	13.35 ±1.84	5.171 ±0.5718
0.4%	72	70	1.16 ±0.11	Nil	50-57	59-113	12.35 ±1.30	5.140 ±0.25923
0.5%	72	65	1.11 ±0.15	Nil	50-57	59-113	10.05 ±1.26	4.630 ±0.26378

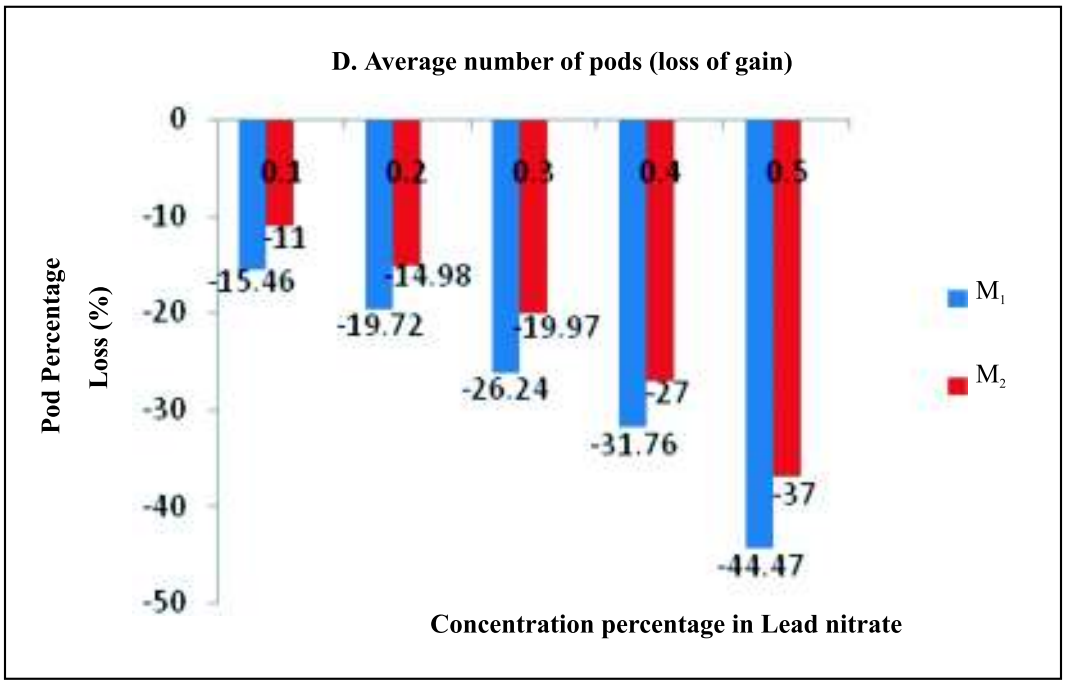
M_2 GENERATION

Treatment Lead nitrate	Germination (%) in field	Seedling survival(%) in field	Height of native plants(m) (±S.D.)	No.of branches per plant	Days taking 1 st flowering	Period of harvesting	No.of pod per plants (±S.D.)	Weight of 100 seeds(gram) (±S.D.)
Control	100	80	1.1 ±0.13	Nil	48-55	57-120	18.42 ±3.14	5.346 ±0.10995
0.1%	86	80	1.22 ±0.17	Nil	48-55	57-120	16.39 ±4.30	5.226 ±0.06745
0.2%	82	78	1.16 ±0.15	Nil	48-55	61-120	15.66 ±2.68	5.176 ±0.04733
0.3%	80	74	1.10 ±0.11	Nil	52-59	61-120	14.74 ±3.33	5.053 ±0.21128
0.4%	80	72	1.0 ±0.11	Nil	52-59	61-113	13.44 ±2.44	4.684 ±0.06535
0.5%	70	66	0.95 ±0.12	Nil	52-59	57-120	11.6 ±2.11	4.405 ±0.11198


A. Average Seed germination (loss of gain)
Germination Percentage
Gain (%)
Loss (%)
0
-5
-10
-15
-20
-25
-30
-35
-2.22
-14
-8.88
-18
-13.33
-20
-20
-20
-20
-30
0.1
0.2
0.3
0.4
0.5
M1
M2
Concentration percentage in Lead nitrate


B. Average seedling servival (loss of gain)
Servival Percentage
Gain (%)
Loss (%)
0
0
-5
-10
-15
-20
-25
-4.76
-4.76
-2.5
-11.9
-7.5
-13.09
-10
-16.6
-17.5
0.1
0.2
0.3
0.4
0.5
M1
M2
Concentration percentage in Lead nitrate


C. Average height (loss of gain)
Height of native plant
gain(%)
Loss (%)
15
10
5
0
-5
-10
-15
13.33
9.09
9.16
5.45
0.83
0
-3.33
-9.09
-7.5
-13.63
0.10%
0.20%
0.30%
0.40%
0.50%
M1
M2
Concentration percentage in Lead nitrate


D. Average number of pods (loss of gain)
Pod Percentage
Loss (%)
0
-10
-20
-30
-40
-50
0.1
0.2
0.3
0.4
0.5
-15.46
-11
-19.72
-14.98
-26.24
-19.97
-31.76
-27
-44.47
-37
M1
M2
Concentration percentage in Lead nitrate

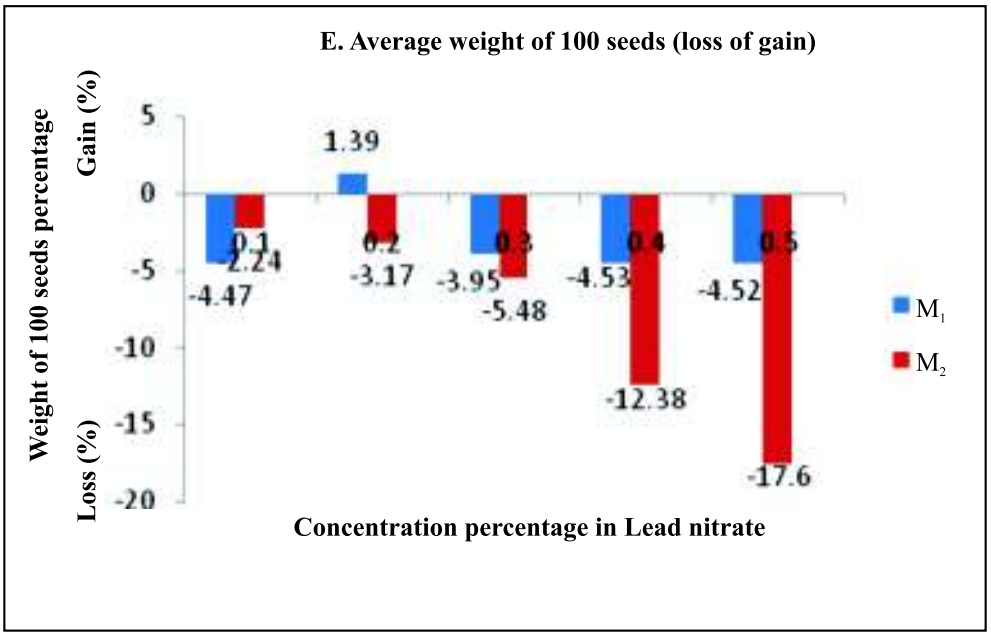


Figure 1 : (A-E): Percentage loss or gain in respect to control in M_1 & M_2 generation in Lead nitrate treated *Abelmoschus esculentus* variety Azad bhindi-1

concentrations of lead nitrate. This finding is similar to the finding of Buts et al., 2011 in *Lens esculentus*(Lentil).

Effect of lead nitrate on seedling survival

In M_1 generation, the average seedling survival of Azad bhindi-1 are 80%, 80%, 74%, 70% & 65% in 0.1%, 0.2%, 0.3%, 0.4%, & 0.5% treatment concentration respectively in comparison to 84% under control.

In M_2 generation, the average seedling survival of Azad bhindi-1 are 80%, 78%, 74%, 72% & 66% in 0.1%, 0.2%, 0.3%, 0.4%, & 0.5% treatment concentration respectively in comparison to 100% under control.

Therefore the above finding showed that the percentage of seedling survival were inversely proportional to the concentration of Lead nitrate. There was a reduction in the percentage of seedling survival at low concentration in comparison to the control but it was much pronounced at higher concentration of lead nitrate in both generations of Azad bhindi-1.

Effect of Lead nitrate on Plant height

Plant height was recorded at the time of maturity on earlier tagged all plants in each treatment. The height was measured from ground level to the point of peduncle and expressed in meter.

In M_1 generation, the average plant height of Azad bhindi-1 are 1.36m, 1.31m, 1.21m, 1.16m & 1.11m in 0.1%, 0.2%, 0.3%, 0.4% & 0.5% concentration respectively in comparison to 1.2m under control.

In M_2 generation, the average plant height of Azad bhindi-1 are 1.22m, 1.16m, 1.10m,1.0m & 0.95m in 0.1%, 0.2%, 0.3%, 0.4% & 0.5% treatment concentration respectively in comparison to 1.12m under control.

Thus, there is an increase in the average height with 13.33%, 9.16% & 0.83% in M_1 generation under the stress of 0.1%,0.2% & 0.3% treatment concentration respectively while it is 9.09% & 5.45% in M_2 generations respectively in 0.1% & 0.2% treatment concentration treated plants respectively in comparison to control. But thereafter with increasing the concentration treatment the height decreases. The maximum percentage decrease in height was observed in 0.5% treatment concentration which is 7.5% & 13.63% in M_1 & M_2 generations respectively.

Therefore, above findings are similar to the findings of Sana Choudhary et al., 2010, who observed that the higher concentrations of lead nitrate significantly reduced plant height in *Trigonellafoenum-graecum* L.

Morphological analysis of M_1 & M_2 generation of

Azad bhindi-1 plants showed that plant height was reduced in the treated population as compared to control.

Effect of Lead nitrate on Number of branches

Lead nitrate does not induce any branching in Azad bhindi-1.

Effect of Lead nitrate on First flowering

Initiation of first flowering is delayed for 3 days at 0.4% & 0.5% treatment concentration of lead nitrate in M1 generation but in case of M2 generation, flowering is delayed for 4 days at 0.2%, 0.3% & 0.4% concentration of lead nitrate.

Therefore, although there is no effect in the initiation of flowering at lower treatment concentration (0.1%, 0.2% & 0.3%). This finding is similar to the earlier finding of Buts et al., 2011) in *Lens esculentus* (Lentil). But at higher treatment concentration, flowering is delayed.

Effect of Lead nitrate on Harvesting

In M_1 & M_2 generation, the period of harvesting is 56-113 in 0.1%, 0.2% & 0.3% concentration same with the control but with increase in the concentration the period of harvesting delayed 3 -4 days in comparison to control.

Thus the delayed in the period of harvesting is not much significant in both generations in treatment concentration taken for study.

Effect of Lead Nitrate on Number of pods

In M_1 generation, the average number of pod per plant of Azad bhindi-1 are 15.3, 14.53, 13.35, 12.35 & 10.05 in 0.1%, 0.2%, 0.3%, 0.4% & 0.5% treatment concentration respectively in comparison to 18.1 under control.

In M_2 generation, the average number of pod per plant of Azad bhindi-1 are 16.39, 15.66, 14.74, 13.44 & 11.6 in 0.1%, 0.2%, 0.3%, 0.4% & 0.5% treatment concentration respectively in comparison to 18.42 under control.

The above data clearly indicate a decrease of 15.46%, 19.72%, 26.24%, 31.76% & 44.47% in 0.1%, 0.2%, 0.3%, 0.4% & 0.5% treatment concentration in M_1 generation under the stress of lead nitrate. Similarly, there is a decrease in the average number of pods per plant are 11%, 14.08%, 19.97%, 27% & 37% in 0.1%, 0.2%, 0.3%, 0.4% & 0.5% treatment concentration respectively in M_2 generation.

Thus, with increasing the treatment concentration of lead, the average number of pods per plant decreases which is maximum in 0.5% treatment concentration. Besides it also indicate towards the development of tolerance in M_2 generation in comparison to M_1 generation in corresponding treatment concentration.

Thus there is a significant decrease in yield with increasing the concentration of lead nitrate in comparison to control (Buts et al., 2006 in broad bean and Buts et al., 2011 in Lentil).

Effect of Lead nitrate on weight of 100 seeds

In M_1 generation, the average weight of 100 seed of Azad bhindi-1 are 5.143gm, 5.309gm, 5.171gm, 5.140gm & 4.630gm in 0.1%, 0.2%, 0.3%, 0.4% & 0.5% treatment concentration respectively in comparison to 5.384gm under control.

In M_2 generation, the average weight of 100 seed of Azad bhindi-1 are 5.226gm, 5.176gm, 5.053gm, 4.684gm & 4.405gm in 0.1%, 0.2%, 0.3%, 0.4% & 0.5% treatment concentration respectively in comparison to 5.346gm under control.

Thus, the weight of seeds also showed reducing trends with increasing the treatment concentration in both M_1 & M_2 generations. The maximum reduction in weight observed were 14% & 17.6% in M_1 & M_2 generation respectively in 0.5% treatment concentration.

Therefore the data showed the reduction of weight with increase of concentration for treatment in both generations of Azad bhindi-1. The 0.4% & 0.5% treatment concentration have comparatively more deleterious effect on weight of seeds.

In the present studies it is observed that lead nitrate @ 0.5% concentration has more deleterious effect on *Abelmoschus esculentus* variety azad bhindi-1 in comparison to control. Increase in the concentration of lead nitrate for treatment increase the deleterious effect on the germination, height of native plant and formation of pods per plant. But the lead nitrate does not induce the branches in any treatment concentration. However it is clear that the germination percentage, pod formation & weight of seeds decrease with increase in treatment concentration of lead

nitrate. Therefore productivity of the crop reduces. Different mutagenic activities of these chemicals were possibly due to difference in their chemical nature and the potency of the ingredient from the observation, however it is clear that none of the concentration applied here was totally lethal. 0.5% treatment concentration of lead nitrate has more deleterious effect in each parameter of both generations.

REFERENCES

Adetuyi F.O., Osagie A.U. and Adekunle A.T., 2008. Effect of Post harvest Storage Techniques on the Nutritional Properties of Benin Indigenous Okra *Abelmoschus esculentus* (L) Moench. Pakistan J. Nutrit. **7**: 652-657.

Buts Vijaya L. Chaudhary and Divya Singh, 2011. Effect of lead nitrate [$Pb(NO_3)_2$] on the growths & development of *Lens esculentus* (lentil). In the proceeding of National Conference on Recent Advanced in Plant Science. :206-211.

Brown M. T. and D. A. Wilkins, 1986. The effect of zinc on germination, survival and growth of Betula. (Series A), **41**: 53-61

Ch. Chandrashekar, D. Sammaiah, M. Rambabu and K. Jaganmoha Reddy, 2011. Effect of cadmium on tomato growth and yield attributes, Journal of Microbiology and Biotechnology Research **1(3)**:109-112.

Ganry J., 2005 fruits and vegetables for healthy diet in developing countries. Acta hort **744**: 55-60.

Kumar S., Dagnoko, S., Haougui, A., Ratnadass, A., Pasternak, D., Kouame, C., 2010. Okra (*Abelmoschus* spp.) in West and Central Africa: potential and progress on its improvement. African J. Agric. Res. **5**: 3590-3598.

Lasat M. M., 2002. Phytoextraction of toxic metals. A review of biological mechanism. Journal of environmental quality. **31**:109-120

Lengsfeld C., Titgemeyer F., Faller G., and Hensel A., 2004. Glycosylated compounds from okra inhibit adhesion of Helicobacter pylori to human gastric mucosa. J. Agric. Food Chem. **52**:1495-1503.

Muhammad Shafiq, Iqbal M., Zafar Mohammad Athar, 2008. Effect of lead on germination and seedling growth of *Leucaena leucocephala*. J. Appl. Sci. Manage **12(2)**: 61-66

Pandit B. R. and Kumar P., 1999. Effect of metals on jowar (*Sorghum bicolour* L.) seedling growth, germination and absorption of elements. Pollut Research, **18**: 307-315.

Shafiq M. and Iqbal M. Z., 2005. The toxicity effects of heavy metals on germination and seedling growth of Cassia siameaLamark. Journal of New Seeds, **7**: 95-105.

Sana Choudhary, Mohammad Yunus Khalil Ansari, Zeba Khan, Honey Gupta, 2012. Cytotoxic action of lead nitrate on cytomorphology of Trigonellafoenum-graecumL.Turk J Biol **36**: 267-273.

Vijayaragavan M. and P. Vijayarengan., 2007. Phytotoxicity of cadmium and its effects on growth and photosynthetic responses in *Raphanus sativus* (L.). Plant Archives, **07(11)**:555-55