UK Journal of Pharmaceutical and Biosciences Vol. 5(3), 14-18, 2017 RESEARCH ARTICLE

UK Journal of Pharmaceutical and Biosciences

Available at www.ukjpb.com

ISSN: 2347-9442

Changes in Seedling Growth and Biochemical Contents in *Abrus precatorius* L. Under Nickel Treatment

Milvee K. Vyas

Department of Biosciences, Veer Narmad South Gujarat University, Udhna Magdalla Road, Surat, 395007, Gujarat, India

Article Information
Received 23 Sept 2016
Received in revised form 10 June 2017
Accepted 11 June 2017

Keywords:
Seedlings,
Nickel,
Abrus precatorius

Corresponding Author:
E-mail : milveevyas4u@gmail.com
Mob.: +919429446797, 9898334427

Abstract

An attempt was made to study the effect of nickel on the growth of *Abrus precatorius*, a medicinal plant growing in South Gujarat used in Ayurved. The seeds of *Abrus precatorius* were germinated in petri dishes by 25, 50, 100, 150, 200 ppm nickel sulphate solution for experimental work. The germination percentage, seedling growth, dry matter yield and changes in biochemical contents of total sugar, protein and pigments were investigated ten days after showing. The study indicates that the lower level of nickel has no adverse effect on germination, seedling growth and biochemical content whereas the higher concentration decreased the same accept the protein. Nickel increased the protein content at lower concentration and has been reducing effect at higher level.

1 Introduction

In the South Gujarat region of the India a large industrial area has been developed, which is known as "Golden Corridor", where large numbers of various types of industries are present. Most of them are chemical, dye, textile, pesticide, pharmaceutical industries, which produce effluent containing heavy metals which contaminate nearby water bodies and sometime certain industries discharge such effluents into lakes and rivers[1]. Such effluent may causes toxicity in the aquatic plants, animals and soil pollution. Irrigation of polluted water, industrial exhausts, and the pesticides as well as fertilizers used in agriculture may cause the contamination of medicinal plants with heavy metals[2].

Certain heavy metals at higher concentration inhibits a cytoplasmic enzymes and damage to cell - structures[3,4]. A precise study of the toxic effect of heavy metals on plant growth, biochemical and various physiological processes was carried out by Chibuike and Obiora[5]. According to certain heavy metals like Pb, Cd, Hg, and As has adverse effect on plant growth even at very low concentration. Kibra[6] studied the effect of Hg on the growth of rice plant and reported significant reduction in height. He also reported reduced tiller and panicle formation under the effect of Hg. The study of Ahmad *et al*[7] has shown that Cd caused the reduction in the growth of root and shoot in wheat plants at the concentration of 5 mg/L. According to Kabata - Pendias[8] the reduction in plant growth is due to reduction of photosynthesis, plant nutrients and enzyme activity.

The use of herbal drugs increases day by day in the present days. Along with the higher demand of herbal drugs, it is necessary that the quality of drugs prepared from the plant must be assured for the utilization. The study of heavy metals pollution is necessary for the overall safety and quality of herbal drugs[9].

Abrus precatorius is a widely growing medicinal plant of South Gujarat. It is a beautiful, perennial wiry, twining climber with weak stem and pinnate and opposite leaves. Flowers are pink or pinkish white and found in auxiliary racemes. Fruit pods are turgid with a sharp deflexed beak, pubescent, linear - oblong, mucronate. Seeds 3 - 5, subglobose, oblong or ovoid.

It is an important medicinal plant used for treatment of diarrhoea,[10, 11] dysentery[12] and gonorrhea.[13] Plant is used in some traditional medicine to treat wounds, sores and scratches caused by dogs, cats, mice and also used with other ingredients to treat leukoderma. Decoction of dry roots is also used to treat bronchitis and hepatitis[14, 15]. Leaves are sweetish in taste and are useful in biliousness, itching and other skin diseases[16]. Seeds administrated in affections of nervous system, and their paste is applied locally in stiffness of shoulder joints and paralysis[17].

Few wokers contributed on the chemical constituents of *Abrus precatorius*. Major constituents are abrasine, abrol[18], abrine[19], abruquinones[20], abrusgenic acid, methyl abrusgenate and abruslactone A[21].

Several wokers carried out pharmacological experiments on *Abrus precatorius.* Ethanolic and petroleum ether extracts of root showed anti - implantation activity in rat[22]. Aqueous extract of the root showed antischistosomal activity[23]. Further, ethyl acetate and methanol extract exhibited *in vitro* antimalarial activity against *Plasmodium falciparum*[24]. Various extracts of the seed of *Abrus precatorius* showed *in vitro* anti - microbial activity[25], larvicidal activity[26] and antifertility activity in rats[27, 28].

The present investigation were carried out to find out the effect of different concentrations of nickel on seed germination, seedling growth and bio chemical content of *Abrus precatorius.*

2 Materials and Methods

2.1 Collection of plant material

The experimental plant *Abrus precatorius* belongs to the family Papilionaceae[29]. Its seeds were collected from the widely grown plant in the campus of V. N. South Gujarat University, Surat of India and sterilized with 0.2% mercuric chloride for the experimental study.

2.2 *Experimental procedure*

Ten seeds were placed in patridishes lined with filter paper. The various concentration of nickel sulphate solution (25, 50, 100, 150 and 200 ppm) were prepared and used for the seed germination and growth studies. The seed germinated with distilled water was treated as control. The germination percentage, seedling growth, dry matter yield and biochemical contents were studied ten days after showing. The results are the average of three replicates.

For the study of dry weight the root and shoot were cut into small pieces and placed separately in brown bags after weighing and kept in oven at 80 ^{0}C for a period of 8 days for drying. The dry weight of these organs was recorded.

The biochemical estimation of total sugar was studied by Nelson[30] method in which the amount of sugar was calculated from optical density obtained by spectrophotometer. Similarly the protein content was determined from optical density following the procedure of Lowery *et al*[31]. For the pigment determination acetone extract of fresh leaves was used and the amount of chlorophyll a, chlorophyll b and carotenoid were calculated by using the formulae given by Machlachlan and Zalik[32] and Duxbury and Yentsch[33].

3 Results and Discussions

3.1 Germination and growth

Present study has showed no effect of the lower concentration of nickel on the germination of seed, growth of root and shoot and dry matter yield. The treatment of higher concentration of nickel reduced the germination, growth of root and shoot and dry matter (Table 1). Similar reduction in shoot and root mass due to higher concentration of nickel was also found in green gram by Vijayarengan and Lakshmanachary[34] and in *Phaseolus vulgaris* by Piccini and Malavolta[35]. The reduction in seed germination and growth attributed to the toxic effect of higher concentration of nickel as suggested by Seregin and Kozhevnikova[36].

3.2 Biochemical studies

The lower level of nickel up to 25 ppm concentration has no effect on pigments like chlorophyll a, chlorophyll b and carotenoid of leaves. Further, higher nickel level decreased the chlorophyll and carotenoid content (Table 2). Panday and Sharma[37] found decreased in chlorophyll content in tomato plant due to exposure of excess concentration of nickel peroxidase. They found that this is associated with the reduction in the activities of Fe enzymes, catalase and peroxidase causing the reduction in pigment content. Kaveriammal and Subramani[38] also suggested that decrease in chlorophyll content due to heavy metal stress is the result of the inhibition of enzymes responsible for the chlorophyll biosynthesis.

Protein content was higher than control at lower concentration of nickel (25 and 50 ppm), further the values decreased with increased in nickel level (Table 3). Similar result about influence of nickel was obtained by Sanghpriya and Panday[39] and Ghasemi *et al*[40] in Zea mays. According to Palma *et al*[41] the decrease in protein content by the treatment of higher concentration of nickel may due to degradation of protein molecules. Such reducing effect also may be due to inhibition of protein synthesis by higher concentration of nickel[42].

Total sugar content remains unaffected at lower concentration of nickel but reduced at higher level of nickel (Table 3). These results are similar to the finding of Ezhilvannn *et al*.[43] in *Arachis hypogaea* and Espan *et al*.[44] in radish. Rabie *et al*.[45] reported decrease in carbohydrates with respect to the high levels of nickel in corn and broad bean and suggested that this decline is due to a role of nickel on the enzymatic reactions related to the cycles of carbohydrates catabolism.

4 Conclusion

From the present study, it was revealed that the lower concentration of nickel has no adverse effect on germination, seedling growth, dry matter yield and biochemical content of *Abrus precatorius*. Higher concentration has an inhibitory effect on these parameters.

Table 1: Effect of nickel on germination, growth and dry matter yield

Concentration (ppm)	Germination (percentage)	Root length (cm)	Shoot length (cm)	Root dry weight (gm/plant)	Shoot dry weight (gm/plant)
Control	96±0.81	6.80±0.08	10.92±0.08	0.212±0.009	0.348±0.008
25	96±0.81	6.65±0.12	11.08±0.21	0.204±0.004	0.356±0.008
50	95±0.81	6.95±0.07	10.82±0.15	0.220±0.004	0.336±0.008
100	90±0.81	5.48±0.32	9.20±0.04	0.196±0.001	0.272±0.002
150	88±0.81	5.08±0.09	8.68±0.15	0.172±0.001	0.260±0.001
200	84±0.81	4.80±0.30	7.80±0.12	0.158±0.001	0.242±0.012

Data in parenthesis represent percentage changes

Table 2: Effect of nickel on leaf pigments (mg/gm)

Concentration (ppm)	Chlorophyll a (mg/gm)	Chlorophyll b (mg/gm)	Carotenoid (mg/gm)
Control	1.90 ±0.06	2.14 ±0.20	1.10 ±0.06
25	1.83 ±0.06 (-3.68)	2.12 ±0.06 (-0.93)	1.08 ±0.04 (-1.82)
50	1.86 ±0.05 (-2.11)	2.08 ±0.04 (-2.80)	1.06 ±0.08 (-3.64)
100	0.92 ±0.08 (-51.58)	1.78 ±0.08 (-16.82)	0.78 ±0.06 (-29.09)
150	0.84 ±0.04 (-55.79)	1.52 ±0.05 (-28.97)	0.70 ±0.04 (-36.36)
200	0.66 ±0.06 (-65.26)	1.32 ±0.06 (-38.32)	0.62 ±0.06 (-43.64)

Data in parenthesis represent percentage changes

Table 3: Effect of nickel on total sugar and protein (mg/gm)

Concentration	Total sugar (mg/gm)		Protein (mg/gm)	
ppm	Stem	Root	Stem	Root
Control	4.20 ±0.28	3.40 ±0.18	6.66 ±0.36	5.90 ±0.28
25	4.15 ±0.35 (-1.19)	3.37 ±0.32 (-0.88)	7.20 ±0.38 (+8.11)	6.42 ±0.34 (+8.81)
50	4.12 ±0.21 (-1.90)	3.35 ±0.26 (-1.47)	6.90 ±0.32 (+3.60)	6.15 ±0.22 (+4.24)
100	3.60 ±0.25 (-14.29)	2.75 ±0.32 (-19.12)	6.00 ±0.30 (-9.91)	5.62 ±0.38 (-4.75)
150	3.08 ±0.15 (-26.67)	2.40 ±0.38 (-29.41)	5.72 ±0.28 (-14.11)	5.02 ±0.30 (-14.92)
200	2.78 ±0.11 (-33.81)	2.02 ±0.28 (-40.59)	4.92 ±0.26 (-26.13)	4.10 ±0.36 (-30.51)

Data in parenthesis represent percentage changes

6 Conflict of interests

Authors have no conflict of interest.

7 Author's contributions

Entire investigation was carried out by MV.

8 References

1. Pandit RJ, Patel B, Kunjadia PD, Nagee A. Pages Isolation, characterization and molecular identification of heavy metal resistant bacteria from industrial effluents, Amala - khadi - Ankleshwar, Gujarat. Int. J. Environ. Sci. 2013; 3 (5) 1689 – 1699.
2. Hussain I, Khan H. Investigation of heavy metals content in medicinal plant, *Eclipta alba* L. J. Chem. Soc. Pak. 2010; 32 : 28 - 33.
3. Assche F, Clijsters H. “Effects of metals on enzyme activity in plants,” Plant, Cell and Environment. 1990; 24 : 1 - 15.

4. Jadia CD, Fulekar MH. "Phytoremediation of heavy metals: recent techniques," African J. Biotech. 2009; 8(6) 921 - 928.

5. Chibuike GU, Obiora SC. Heavy Metal Polluted Soils: Effect on Plants and Bioremediation Methods. Applied and Environmental Soil Sci. 2014; 12.

6. Kibra MG. "Effects of mercury on some growth parameters of rice (Oryza sativa L.)," Soil & Environment. 2008; 27(1) : 23 - 28.

7. Ahmad I, Akhtar MJ, Zahir, ZA, Jamil A. "Effect of cadmium on seed germination and seedling growth of four wheat (*Triticum aestivum* L.) Cultivars," Pak. J. Bot. 2012; 44(5) 1569 - 1574.

8. Kabata - Pendias A. Trace Elements in Soils and Plants, CRC Press, Boca Raton, Fla, USA, 3rd edition, 2001.

9. Baye H, Hymete A. Levels of Heavy Metals in Common Medicinal Plants Collected from Environmentally Different Sites. Middle - East J. Sci. Res. 2013; 13(7): 938 - 943.

10. Hembrom PP. Contact therapy practiced by Mundas of Chotanagpur (Bihar). Ethnobotany. 1996; 8 (1 and 2) : 36 – 39

11. Tandon N. Medicinal plants and preparations used for the management of certain water borne diseases. Ph.D. Thesis S. G. University, Surat, India. 2008.

12. Rao KP, Sreeramulu SH. Ethnobotany of selected medicinal plants of Srikakulam district, Andhra Pradesh. Ancient Sci. Life. 1985; 4(4) : 238 - 244.

13. Devi Prasad AG, Shyma TB, Raghavendra MP. Traditional herbal remedies used for management of reproductive disorders in Wayanad district, Kerala, India. Int. J. Res. Pharm. Chem. 2014; 4 (2): 333 - 341.

14. Attal AR, Otari KV, Shete RV, Upasani CD, Nandgude TD. *Abrus precatorius* Linnaeus: a phytopharmacological review. J. Pharm. Res. 2010; 3 (11): 2585 - 2587.

15. Garaniya N, Bapodra A. Ethno botanical and Phytophrmacological potential of *Abrus precatorius* L.: A review. Asian Pac. J. Trop Biomed. 2014; 4 (1): S27 - S34.

16. Joshi SG. Medicinal Plants. Oxford and IBH Pub. Co. Pvt. Ltd. New Delhi, India. 2000.

17. Ambasta SP (ed.). The useful plants of India. National institute of science communication and information resources. CSIR, New Delhi. 1986.

18. Khaleqe A, Aminuddin, M, Mulk SAU. Investigations on *Abrus precatorius* L. Constituents of dry root. Pak. CSIR. Bull. Monogr. 1966; 3 : 203 - 207.

19. Karawaya MS, El - Gengaithi S, Wassel G, Ibrahim N. Phytochemical studies of *Abrus precatorius* alkaloids. Herba Hung. 1980; 19 : 21 - 25.

20. Lupi A, Delle Monache F, Marini - Bettolo GB, Costa DLB, D'Albuquerque, IL. Abruquinones: New natural isoflavanquinones. Gazzetta Chimica Italiana. 1979; 109 : 9 - 12.

21. Chiang TC, Chang HM, Mak TCW. New oleanene type triterpenes from *Abrus precatorius* and X - ray crystal structure of abrusgesic acid - methanol 1 : 1 solvate. Planta Medica. 1983; 49 : 165 - 169.

22. Agarwal SS, Ghatak N, Arora RB, Bhardwaj MM. Antifertility activity of the roots of *Abrus precatorius* L. Pharmaco. Res. Comm. 1970; 2 : 159 - 163.

23. Sparg SG, Van Staden J, Jager AK. Efficiency of traditionally used South African plants against schistosomiasis. J. Ethnopharmaco. 2000; 73 : 209 - 214.

24. Bagavan A, Rahuman AA, Kaushik NK, Sahal D. *In vitro* anti malarial activity of medicinal plant extracts against *Plasmodium falciparum.* Parasitol Res. 2011; 108 : 15 - 22.

25. Adelowotan O, Aibinu L, Adenipekun E, Odugbemi T. The *in vitro* antimicrobial activity of *Abrus precatorius* L. Fabaceae extract on some clinical pathogens. Niger Postgrad Med. J. 2008; 15 : 32 - 37.

26. Bagavan A, Rahuman AA. Evaluation of larvicidal activity of medicinal plant extracts against three mosquito vectors. Asian Pac. J. Trop. Med. 2011; 4 : 29 - 34.

27. Rao, MV. Antifertility effects of alcoholic seed extract of *Abrus precatorius* L. in male albino rats. Acta Eur. Fertil. 1987; 18 : 217 - 220.

28. Sinha R. Post - testicular antifertility effects of *Abrus precatorius* seed extract in albino rats. J. Ethnopharmaco. 1990; 28 : 173 - 181.

29. Shah GL. Flora of Gujarat State. Vol. I and II. Sardar Patel University, Vallabh Vidhyanagar, Gujarat, India. 1978.

30. Nelson N. A photometric adaptation of the Somogyi method for the determination of glucose. J. Biol. Chem. 1944; 153 (3): 375 - 380.

31. Lowry OH, Rosebrough NJ, Farr AL, Randall RJ. Protein measurement with Folin phenol reagent. J. Biol. Chem. 1951; 193(1): 265 - 275.

32. Machlachlan S, Zalik S. Plastid structure, chlorophyll concentration and free amino acid composition of chlorophyll mutant on barley. 1963; Can. J. Biol. 41 : 1053 - 1062.

33. Duxbury AC, Yentsch CS. Plankton pigment monographs. J. Marine Res. 1956; 15 : 91-101.

34. Vijayarengan P, Lakshmanachary AS. Effects of nickel on growth and dry matter yield of greengram cultivars. Ind. J. Environ. Hlth. 1995; 37(2): 99 - 106.

35. Piccini DF, Malavolta E. Effect of nickel on two common bean cultivars. J. Plant Nutr. 1992; 15 (11): 2343 - 2350.

36. Seregin IV, Kozhernikova AD. Physiological role of nickel and its toxic effects on higher plants. Russ. J. Plant. Physiol. 2006; 53(2): 257 - 277.

37. Pandey N, Sharma CP. Effect of heavy metals Co2+, Ni2+ and Cd2+ on growth and metabolism of tomato plants. Plant Physiol. 2003; 35(2): 112 - 117.

38. Kaveriammal S, Subramani A. Toxic effect of nickel chloride on the growth behavior and biochemical constituent of groundnut seedling (*Arachis hypogeaea* L). Int. J. Research in Botany. 2013; 3(4): 48 - 52.

39. Sanghpriya G, Pandey SN. Growth and biochemical responses of nickel toxicity on leguminous crop (*Lens esculantum*) grown in alluvial soil. Res. Environ. Life Sci. 2008; 1(1): 25 - 28.

40. Ghasemi F, Heidari R, Jamii R, Purakbar L. Responses of growth and anti oxidative enzymes to various concentrations of nickel in *Zea mays* leaves and roots. Rom. J. Biol. - Plant Bio. 2013; 58(1): 37 - 49.

41. Palma JM, Sandalio LM, Corpas FJ, Romero - Puertas MC, McCarthy I, del Rı´o LA. Plant proteases, protein degradation, and oxidative stress: role of peroxisomes. Plant Physiology and Biochemistry. 2002; 40 (6 - 8): 521 - 530.

42. Maheshwari R,.Dubey RS. Nickel toxicity inhibits ribonuclease and protease activities in rice seedlings: protective effects of proline. Plant Growth Regul. 2007; 51(3): 231 - 243.

43. Ezhilvannan D, Sharavanan PS, Vijayaragavan M. Changes in growth, sugar and starch contents in groundnut (*Arachis hypogaea* L.) plants under nickel toxicity. Curr. Bot. 2011; 2(8): 24 - 26.

44. Espen L, Pirovano L, Sergio MC. Effect of Ni2+ during the early phases of radish (*Raphanus sativus*) seed germination. Environ. Exp. Bot. 1997; 38(2): 187 - 197.

45. Rabie MH, Eleiwa ME, Aboseoud MA,.Khalil KM. Effect of nickel on the content of carbohydrate and some minerals in corn and broad bean plants. J. K. A. U. Sci. 1992; 4: 37 - 43.