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STUDY OF ALUMINIUM METAL IN FABRIC DYE EFFLUENT USED FOR IRRIGATION PURPOSE IN BIKANER CITY OF RAJASTHAN

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ABSTRACT

Present study is related with Chopra Bari area of Bikaner city, which uses fabric dye effluent for irrigation practices. Generally, aluminium (Al) is used as a mordant in dye to increase the fastness of finished product. In this area, dyers used to dye silk in first quarter of the year, while cotton, wool and fast colour fabrics in second, third and fourth quarters, respectively. Study revealed that aluminium concentration remains toxic in each and every quarter. High concentrations of aluminium limits plant growth and development especially of roots. Root apex seems to be the major target of aluminium toxicity.

Key words: Aluminium, Toxicity, Effluent, Irrigation.

INTRODUCTION

Mordant dyes are dyes, which require a mordant in their application and which upon combination with the mordant deposits insoluble color on the substrate. e.g. dyes with metal chelating groups. Mordants are substance of organic or inorganic origin, which combine with the coloring matter and are used to fix the same in the production of the color. For the purpose of this class, materials such as oils and sulfonated oils, soap fats and higher acids are not generally considered as mordant but as coming within the scope of "assistants" in dyeing. The mordant substance include acids such as tannic acid, sumac, gall nuts, bark extracts, oleic acids, stearic acids and jurkey red oil and metallic substances such as various combinations or soluble salts of chromium, aluminum, iron, copper and zinc. The latter metallic mordants are used more than the acid mordants. Mordant improves the fastness of the dye on the fiber such as water, light and perspiration fastness[1-3].

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In Bikaner city, there is a Chopra Bari area, which is a leading producer of vegetables in the city. The area exports nearly one tone of vegetables per day in each and every part of city. For irrigation purpose, farmers are using industrial effluent of dyeing and printing units. There are two main origins of effluents in city. One is Lal Guffa area (near Goga Gate) and other is Laxminath Temple Valley (Chimpa Mohalla & Rangera Mohalla). From both these areas, effluent reaches to Chopra Bari area through small and big drains where finally, it is used for irrigation purpose. Various fibers such as silk, cotton, wool etc. are dyed according to seasons.

No hand pump or tube well is present in this area for irrigation purpose. The total area covers a land of 3,60,000 sq.feet and each and every type of vegetables/fruits like potato, wheat, barley, maize, tomato, spinach, corrinder, raddish, brinjal, citrus, onion, bathua etc. are grown here and are transported in each and every part of the city.

Aluminium is one of the heavy metals used by dyers in dyes especially in beet dyes, lac dyes, vegetable dyes such as alkanet, cutuch, heena, madder, cochineal, kamala and myrobalan

Various types of disorders are seen in plants/crops growing in Chopra Bari area like fall of fruits before ripping, stunted growth, diesel soaked appearance of leaves, blackening of roots, chlorosis, moisture stressed plants etc., which might be due to use of effluent of dyeing and printing units.

Keeping in view disorders in plants/crops in area under investigation, the proposed study has been undertaken.

EXPERIMENTAL

The experimental work was done in all the four quarters separately. For experimental work, whole area was divided in twenty zones, which were given name Z-1 to Z-20. These zones were situated at a distance of 30 meters from one another.

The samples were collected in wide-mouth plastic bottles. Prior to sampling the plastic bottles were thoroughly washed with tap water, detergent wash, distilled water and soaked in 1% nitric acid for 24 hours, and then washed with double distilled water[4,5].

Aluminium concentration was determined using AAS.

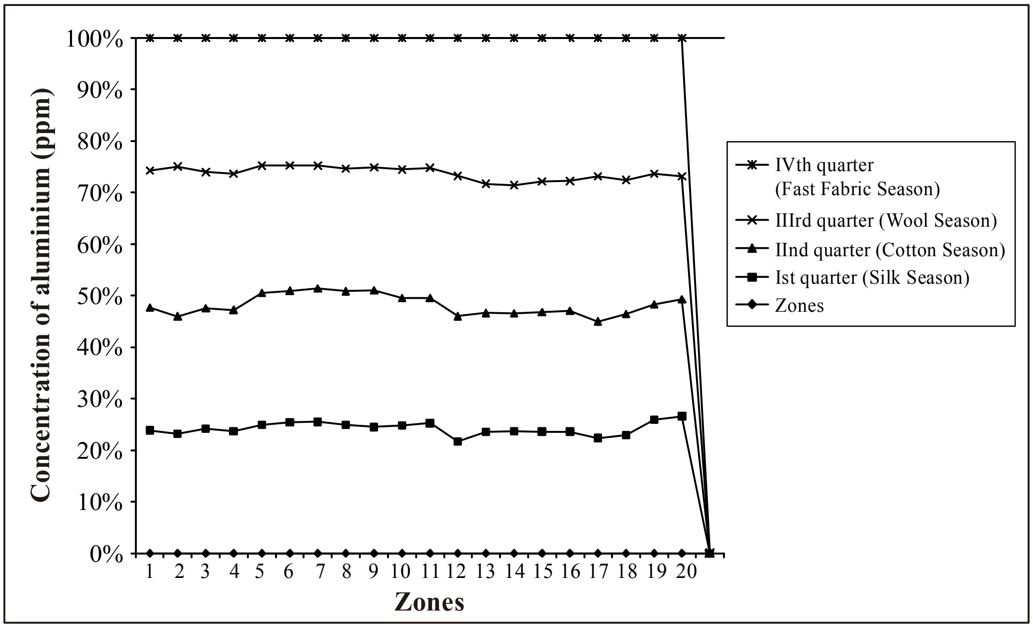
Aluminium was determined by using nitrous oxide flame at wavelength of 309.3 nm. The standard solution was prepared to calibrate the instrument[6].

RESULTS AND DISCUSSION

Aluminium concentration (in ppm) so obtained in four quarters is –

Zones	I^st quarter (Silk Season)	II^nd quarter (Cotton Season)	III^rd quarter (Wool Season)	IV^th quarter (Fast fabric Season)
Z-1	6.20	6.20	6.90	6.70
Z-2	6.30	6.18	7.90	6.78
Z-3	6.38	6.17	6.98	6.88
Z-4	6.24	6.19	6.96	6.92
Z-5	7.01	7.20	6.92	6.97
Z-6	7.25	7.30	6.94	7.07
Z-7	7.30	7.40	6.80	7.09
Z-8	7.21	7.51	6.85	7.35
Z-9	7.21	7.81	7.02	7.40
Z-10	7.20	7.20	7.23	7.41
Z-11	7.25	6.98	7.25	7.23
Z-12	6.25	6.97	7.80	7.70
Z-13	6.31	6.16	6.70	7.56
Z-14	6.40	6.15	6.72	7.70
Z-15	6.31	6.17	6.76	7.42
Z-16	6.30	6.23	6.70	7.39
Z-17	6.21	6.24	7.81	7.43
Z-18	6.21	6.33	7.02	7.45
Z-19	7.39	6.40	7.23	7.50
Z-20	7.48	6.41	6.70	7.57

Plant requires 5.0 ppm aluminium in irrigation water for their normal growth functions. Perusal of above data indicates that whole of the year, effluent is quite rich in aluminium concentration. In silk season, it is found in 6.20-7.48 ppm range, while in cotton, wool and fast dye season, its concentration remains 6.15-7.81 ppm, 6.70-7.90 ppm and 6.70-7.70 ppm, respectively. It develops aluminium toxicity in plants roots. Inhibition of root and shoot growth is visible symptoms of aluminium toxicity. Root stunting is a consequence of aluminium induced inhibition of root elongination. Roots are usually stubby and brittle and root tip becomes thick. Such types of roots cannot absorb water and nutrients.



Shoots shows cellular and ultra-structural changes in leaves, increased rates of diffusion resistance, stomatal aperture decreases, reduced photosynthetic activity leading to chlorosis and necrosis of leaves, total decrease in leaf number and size and decrease in shoot biomass.

Aluminium induced growth inhibition to stabilization of microtubules in the central elongination zone. With this aluminium also interacts with the factors that influence organization of cytoskeleton and composition of plasma memberane.

Aluminium apparently does not interfere with seed germination but it does impair the growth of new roots and seedling establishment.

Aluminium toxicity also results in peroxidation of lipids. Aluminium is known to modify the elemental composition of plant tissues by interfering with ion uptake and translocation.[7]

Aluminium is absorbed on all Ca-binding sites on the cell surface. In the intact tissues, most of the aluminium is bound to the pectic substances of the cell wall and a part to the nucleic acids and cell membrane.

Aluminum toxicity is a major factor in limiting growth in plants. Toxic effects on plant growth have been seen in several physiological and biochemical pathways. In general, root elongation is hampered through reduced mitotic activity induced by aluminium, with subsequent increase in susceptibility to drought. The initial site of uptake is usually the root cap and the mucilaginous secretion covering the epidermal cells. Aluminium ions bind very specifically to the mucilage by exchange adsorption on the polyuronic acid, complexing with the pectic substances and by the formation of polyhydroxy forms, increasing the number of aluminium atoms per positive charge.

Aluminum interferes with the uptake, transport and use of several essential elements, including Cu, Zn, Ca, Mg, Mn, K, P and Fe. Excess of aluminium reduces the uptake of certain elements and increases that of others; the patterns being dependent on the element, the plant part and species involved.[8]

From the above study, it may be suggested that effluent used for irrigation is highly toxic in aluminium concentration and it requires treatment before use.

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