CHAPTER-II

| REVIEW |

OF

LITERATURE
Like other medicinal plants such as Nicotiana, Erythroxylon truxillense, Atropa belladona, Datura stramonium, Papaver somniferum, Lophophora williamsil, Cinchona succirubra, Rauwolfia serpentina etc, *Boerhaavia diffusa* Linn. (Common name Gadahpurna) has also an extra importance in the field of medicine for its medicinal value (Bonner and Varner, 1983).

Punarnava, *Boerhaavia diffusa* L. (Rakta Punarnava), belonging to the family Nyctaginaceae is a popular indigenous drug commonly used as a diuretic, and urinary analgesic in the treatment of oedema (Kritikar and Basu, 1933; Nadkarni, 1954). Two Chief varieties are described, one with white flowers called Sweta Punarnava and the other with red flowers called Rakta Punarnava. The extensive reference to this plant in Ayurvedic literature has attracted many scientific and several Pharmacognostical workers (Prasad, 1948; Dutta and Mukherjee, 1952; Singh, 1969 and Surange et al., 1972, 1973).
Pharmacological (Basu, 1910; Chopra et al., 1923; Gujral 1955; Basu et al., 1947; Karandikar et al., 1960; Harvey, 1966; Singh, 1969; Seth and Sethy, 1970; Mudgal, 1975, 1977 and Bhalla et al., 1971), Phytochemical (Chopra et al., 1923; Agrawal and Dutta, 1934; Singh, 1969, 1972; Misra 1971; Srivastava et al., 1972 and Seth et al., 1986) and Clinical (Chopra et al., 1923; Singh, 1969 and Singh & Udupa, 1972) studies have been carried out on this drug in past.

Nadkarni (1954) has described various name of Boerhaavia diffusa in different languages:-

Sans. : Punarnava; Shothaghni (Cure of dropsy).

Eng. : Spreading hog weed.

Hin. : Beshakapore; Gadhapurna; Thikri; Sant.

Punj. : Itsit.

Ben. : Gandhapurna; Swetapoorna; Punarnaba.


Bom. : Ghetuli, Satodimool; Motosatado.

Tel. : Attatamamidi.

Tam. : Mikkavatil; Mukukrattai; Kadiyirattam.

Mal. : Tamiliama; Talutama.
According to Ramaswamy and Razi (1973) the leaves of *Boerhaavia diffusa* are used as a green vegetable. The root is used in disease of heart and kidney and in gonorrhoea and dropsy. Haines (1963) also reported that the root of *Boerhaavia diffusa* is also used as laxative, diuretic and stomachic. Also the leaves are eaten as a pot herb and the root is given in diarrhoea, dysentery and Cholera (Mathur, 1973).

According to Chopra et al., (1956) the root of *Boerhaavia diffusa* Linn. belonging to the family Nyctaginaceae has an extra ordinary medicinal value such as diuretic, laxative, expectorant, in asthma, stomachic, in oedema, anemia, jaundice, ascites, anasarca, scanty urine and internal inflammation, antidote to snake venom. The total alkaloid content of root of B. diffusa is 0.04%. The active alkaloid present in root is “Punarnavine”.

Surange et al., (1972) reported that the comparative pharmacognostic studies on root of genuine and commercial samples of B. diffusa L. (Punarnava) show the presence of alkaloids, which vary between 0.054 to 0.196%.
Chopra et al., (1923) reported the presence of large quantities of potassium salts (KNO₃) and a alkaloid called Punarnavine. Kirtikar and Basu (1933) also reported the presence of an alkaloid, Punarnavine. Nadkarni (1954) reported that the air dried plant found to contain usually large quantities of potassium nitrate. An alkaloid is present in very small quantity about 0.01% of the weight of dry plant. It had a bitter taste and the hydrochloride was obtained in crystalline form. It has been named Punarnavine. It contains a sulphate of a body alkaloidal in nature (Punarnavine) 0.01%, potassium nitrate 6.41%, an oily amorphous mass of the nature of a fat; sulphate and Chlorides and traces of nitrates and chlorates from the ash.

Misra and Tiwari (1971) studied phytochemistry of this plant and found the presence of Hentriacontane (C₃₁H₆₄). β-sitosterol (C₂₉H₅₀O) and Urosolic acid (C₃₀H₄₈O₃) in the root of B. diffusa.

Singh and Udupa (1972) and Srivastava et al., (1972) described the isolation and identification of a steroid from B. diffusa Linn. A steroid with m.p. 136°C, C-84.07%, H-11.61%, M⁺ 416% consistent with the molecular formulae
C₂₉ H₅₀O has been isolated from Punarnava. Seth et al., (1986) has described the estimation of Punarnavoside, a new antifibrinolytic compound from B. diffusa.

Kirtikar and Basu (1944) reported that the red variety of Punarnava has been described to be bitter, cooling, astringent to the bowels, useful in billiousness, blood impurities, leucorrhoea, anaemia and inflammation. The root is well known for its diuretic properties. It is also useful in jaundice, ascites, anasarca, scanty urine and internal inflammation. Singh (1969) has also described it as anti-inflammatory, anti-bacterial drug specially against Escherichia coli and regenerative effect on kidney.

Bhalla et al., (1971) revealed that the acetone extract of the plant was most potent both on carrageenin induced oedema and formaldehyde induced arthritis. Mudgal (1974) found diuretic and anti-inflammatory activity in roots and leaves. Mudgal et al., (1977) concluded that increased rate of biosynthesis of active principle in flowering or growing season is responsible for the increased medicinal properties of these plants in the respective season.

In the year 1985 the monogram of phytochemical investigation of plants by CCRAS described Boerhaavia diffusa Linn. (Syn. B. ripens) family-
Nyctaginaceae (Rakta-Puspa, Sothaghiai, Varyakatu) to possess following qualities (gunkarma) in Ayurveda.

- Rasa: Tikta
- Guna: Laghu
- Vipaka: Katu
- Virya: Usna

Karandikar et al., (1960) noted diuretic effect in B. diffusa nearly equal to Urea. A comparison of the diuretic effect of the drug with the effect of equivalent amount of potassium chloride indicated that the diuretic activity of B. diffusa was entirely due to its potassium content.

Pandey and Sinha (1972) reviewed the use of hormone in agriculture. Now a day IAA, IBA, NAA and 2, 4-D are most widely used in soaking seeds for germination. Pre-sowing treatment of seeds of Phaseolus ureus with IAA, IBA, NAA, 2,4-D etc. resulted an increase in length of hypocotyl at low
concentration and shortening at higher concentration. NAA and IBA are reported to stimulate germination of C. *Capsularis*, C. *olitoreus*, Crotolaria *junccea* etc. The accelerating effect of GA on germination of seeds of *Morus indica* was also reported.

The promotion of seed germination by light was noted in 1860 and inhibition in 1903 (Evenari, 1957, Toole et al., 1959). The repeated reversibility of the photoreaction which controls germination of lettuce seed was established in 1952 (Borthwick et al., 1952 b).

Auxin isolated from urine was first demonstrated to have root forming property. Thimann and went (1934), Thimann and Koepfli (1935) and Kogl (1935) proved that the root-forming/root-growth substance is identical to IAA. They also obtained better root growth in *Rhizopus* with the application of IAA. Chaudri and Gaur (1953) observed the inducing property of IAA for the formation of largest number of roots in Durania cuttings.

NAA has also been used for rooting with varying degree of success (Zimmerman and Wilcoxon, 1935). NAA was also found to induce root formation in *Psidium guajava* L. (Singh, 1950). Singh and Teotia (1951) observed 100%
rooting in mango var. Desehri and Langra. Sengupta and Chattopadhyay (1954) also observed inducing effect of NAA on rooting in Carica, Chorchorus and Euphorbia spp. Sircar and Kundu (1960 b) and Mukherjee et al., (1964) recorded an increase in number and length of root in rice and water hyacinth with IAA and NAA. Gopalkrishnan (1964) and Sircar (1958) also obtained stimulatory effect on root growth in rice with the application of IAA.

It has, more recently, been found that the action of auxin in roots is similar to that in stem, but that the concentration of auxin stimulatory to stem growth are inhibitory to root growth. In other words, roots are much more sensitive to auxin that stems, and real stimulation of root elongation may achieved if low enough concentration are used (Devlin and Jackson, 1961; Jackson, 1960). Pandey and Sinha (1972) also reviewed the effect of NAA on mango varieties and noted that 10% NAA induced 100% rooting in Desehri while 20% in Langra. They also reported that not only root initiation is inhibited but that the stimulation of rooting caused by auxin is also counteracted. The inhibitory effect was observed in Sorghum and Trifolum spp. The application of relatively high concentrations of IAA to roots not only retards root elongation but causes a noticable increase in the number of branch roots.
The question of whether growth rates of roots correlate with their content of IAA has been approached with bioassay techniques and more recently, with an immunological procedure, a radio immunoassay (Pengelly and Torrey, 1982; Wieler, 1984). A fairly good correlation was found between growth rate and IAA content. Mulkey et al., (1982) observed that higher concentrations of IAA (1 μM) were still strongly inhibitory. Synthetic auxins such as NAA and IBA are usually more effective than IAA. Sircar and Chakraverty (1960) reported that GA promotes root growth in jute. Butcher and Street (1960 a, b) obtained increase in elongation of tomato root.

The work of several workers as reviewed by Black and Edelman (1970) on gibberellic acid shows that with the application of gibberellic acid to the leaf blade or in the axil, cabbage grow several feet tall and lettuce become vine like. Many dwarfs (e.g. dwarf maize, peas) treated with gibberellin have a long stem with little or no branching. In the cereals (e.g. maize and rice), internodal growth extension of leaf sheath and blade are all promoted.

Most dicots and some monocots respond by growing faster when treated with gibberellins (Pharis and Kuo, 1977). Cabbage and other species in the rosette
form grow tall and then flower after GA$_3$ application, while untreated plants remain short and vegetative. Short bush beans become climbing pole beans and genetic dwarf mutants of rice, maize, peas, watermelons, squash and cucumber exhibit phenotypically tall characteristics of normal varieties when treated with GA$_3$ or certain other gibberellins.

Phinney and Spray (1982) observed that only GA, controls stem elongation in maize. Similar new studies by Phinney suggest that only GA, controls stem elongation in rice and peas. Yun-Ling et al., (1997) observed that application of GA to Arabidopsis thaliana L. in short day conditions resulted in rapid stem elongation and flower formation. Milsamranchit et al., (1997) studied the effect of plant growth regulators on the growth in a medicinal plant, Ceranium and found that GA$_3$ treatments increased the number of leaves. Peng and Nicholas (1997) noted that plant growth and development are regulated by number of internal and external factors. Among these, gibberellin and phytochrome often influence the same process. In plants grown in the light Arabidopsis thaliana hypocotyl elongation is reduced by GA deficiency and increased by phytochrome deficiency.
The commercial powder, such as Rootex, in which cut ends of stem are dipped to facilitate root production usually contains IAA or NAA mixed with inert talcum powder.

The work on physiology of flowering has been extensively reviewed by Lang (1952, 1965), Doorenbos and Wellensiek (1959), Salisbury (1961, 1963), Hillman (1964), Searle (1965), Chailakhyan (1968) and Kolli (1969).

Chailakhyan (1968), in his review, opined that flowering is a decisive stage in a plant’s life and attracts scientists attention because it precedes fruiting connected with the yielding ability of crop. Auxins and growth promoting substances, which function as auxins, have indirect influence, and do not play a decisive role in plant flowering; they can not be considered direct regulators of flowering.

Dostal and Hosek (1937) reported inhibition of floral initiation by applied IAA to the leaves of Circaea. Similar results were also found by Hamner and Bonner (1938) in Xanthium. Cholodny (1939) clearly formulated the view that high auxin levels in the soyabean plant may be unfavourable to flowering. Mathur (1963) reported that treatments of NAA caused early flowering, where as NOA and
IAA delayed it. Lincoln and Hamner (1958) applied gibberellic acid \((GA_3)\) to cocklebur and showed improvement in flowering behaviour. Harada and Nitsch (1959) showed that Chrysanthemum was not to induce flower by GA but the Japanese variety was induced to flower. Zhu & Davies (1997) working on pea lines (dwarf and tall) found an increase in flowering.

Mathur and Mittal (1964) obtained greater flower formation in cotton when gibberellic acid was sprayed on the cotton plant just before flower initiation. Chailakhyan (1968) reviewed that some gibberellins affect flowering while others do not, for example, in an experiment on Myosotis alpestris, \(GA_3\) influenced only stem formation while \(GA_7\) stimulated both stem formation and flowering.

Mathur (1963) studied the effect of auxins on boll-setting in cotton and found that the treatment not only caused significant increase in boll-setting, but also caused earliness. Crane (1964), in his review, opined that “fruit-setting by growth regulators is a function of their auxin-activity”. The significance of auxin in fruit-setting has been recognised for over 30 years. Fruits such as egg plant, fig, grape, and tomato may be set by auxin application and their ultimate size and development may not be greatly different from their pollinated counterparts. Other
fruits however, such as the apple, apricot, avocado, and pear may be set by auxin application but fail to grow to normal size. The majority of fruits, particularly of the drupe type such as cherry, peach, plum fail to respond to auxin application.

Malkani and Asana (1958) working on American cotton, obtained significant in yield of seed cotton per acre with the application of NAA. Mathur (1963) also observed an increased in the yield of seed cotton when IAA was sprayed on the plant.

Fruits that can be set in varying degree with auxin, but also equally well or better with GA, are the tomato, fig, cucumber, egg plant, pepper, pear, apple, currant etc. The grape, particularly the Black corinth variety, has been widely and erroneously cited as responding to GA application by increases in fruit-set. Crane (1964) has described, in his review, GA to be more effective than any other growth substances in setting tomato. Increases in fruit size over control as a result of GA treatment has been reported in the Black corinth and Thompson seedless grapes.