Chapter-IV
Discussion
DISCUSSION

The carmel coloured and obnoxious smelling DE acidic pH, E.Ce. 3.55 m mhos/cm² at 25°C and SAR 0.918 and turbid grayish white chrome tannery effluent with tanning smell, alkaline pH, E.Ce. 1.35 m mhos/cm² at 25°C and SAR 0.698 were not only found rich in organic and sodium contents such as calcium, potassium, magnesium, phosphorus, sulphur, iron, manganese, copper zinc and chloride. The chrome tannery also contained carbonate, bicarbonate and chromium. These observations are quite in agreement with Pande (1985).

The composition of distillery effluent reported in this work is an agreement with the reports of NEERI, (1970-71) for K; Dahiya et al., (1975) and Stupielo, (1977) for K and P; Chatterjee, (1978) for Ca, Mg, P and S; Chakrabarty, (1964) for Na, K and Fe; Samuels, (1980) for Ca, K, Mg, S, Cu and Zn; Joshi et al., (1980) for K; Singh et al., (1980) for Na, Ca, K, Mg and Zn and Pandey, (1985) for Na, Ca, K, Mg, P, S, Fe, Mn, Cu and Cr.

The observations for chrome tannery effluent presented here are almost in conformity with the reports of Thabaraj et al., (1964) for chloride, sodium, calcium, potassium, magnesium, phosphate, sulphate and chromium; Chakrabarty, et al., (1966) for TSA and chloride; Chattopadhya et al., (1973); Bharti et al., (1979) and Indian Standard (1977) for colour and pH; Gupta et al., (1981), Rao and Kumar (1981 for chromium and pH; Kamalam and Raj (1980) for chloride, sodium and sulphate; Khanna and Handa (1982-83) for pH: carbonate, chloride and
sulphate; George (1984) for carbonate, bicarbonate, chloride, sulphate, calcium and magnesium; Pande (1985) for colour, odour, pH, E.Ce. SAR, Ws carbonate, bicarbonate, TSA, chloride, sulphate, phosphate, sodium, calcium, potassium, magnesium, iron, manganese, copper, zinc and chromium and Mainivasakam (1987) for colour, odour, pH, chloride, sulphate and sodium.


For the work presented in this thesis soil ESP, the index of sodicity of sodic soils, was determined by the SAR method in view of the findings reviewed and discussed by Sinha, (1967); Agarwal et al., (1979a, 1979e and 1987). These authors in accord with Overstreet and Shuiz et al., (1965); Agarwala and Tripathi (1974) have found that under highly saline and certain other conditions soil ESP cannot be accurately determined by ammonium acetate method. Kelly (1964) suggested that this could be due to dissolution or double decomposition of water soluble substances in soils by ammonium as well as other solutions used for exchange, or difference in the solubility of substances in water and ammonium acetate or other salt solutions or an infrequent delay in salt solutions to reach exchange equilibrium with soil. Bower and Hatcher, (1962); suggested that under such conditions ESP determined by AR method could provide a more dependable attribute or sodicity.
In this results presented here soil ESP, E.Ce., pH, SAR, Ws CO$_3^-$, HCO$_3^-$, TSA, PO$_4^{3-}$, Na$^+$, Fe$^{++}$ and Zn$^{++}$ showed higher values in HSS soils as compared to LSS followed by NSNS soils; Ws Cl$^-$ and Mn$^{++}$ showed higher values in HSS soils as compared to LSS soils followed by NSNS soils in DE treatment; Ws Mg$^{++}$ showed higher values in HSS soils as compared to LSS soils moisture content; percent organic matter in soils, rate of water percolation (cm/hr.), Ws Ws K$^+$ and Cr$^{+++}$ showed higher values in NSNS soils as compared to LSS soils followed by HSS soils; ml water required for saturation per 100 gm. Soils, soil Ws SO$_4^{2-}$, Ca$^{++}$ and Cu$^{++}$, showed higher values in LSS soils as compared to HSS soils followed by NSNS soils; Ws Mn$^{++}$ and Cl$^-$ showed higher values in LSS soils as compared as HSS soils followed by NSNS soils and Ws Mg$^{++}$ showed higher values in HSS soils as compared to NSNS soils followed by LSS soils in DE treatment.

In both DE and TE treatments soil ESP, E.Ce., pH, SAR, ml. water required for saturation of soils, Ws Co$_3^-$, HCO$_3^-$, TSA, Ws Cl$^-$, PO$_4^{3-}$, SO$_4^{2-}$, Na$^+$, Mg$^{++}$, Fe$^{++}$, Mn$^{++}$, Cu$^{++}$ and Zn$^{++}$ showed positive correlations amongst themselves and negative correlations with each of the % moisture content in air dry soil, rate of water percolation, % organic matter in soils, Ws Ca$^{++}$, K$^+$ and Cr$^{+++}$ found positively related with each other amongst themselves. Except those with Ws PO$_4^{3-}$, SO$_4^{2-}$, Mg$^{++}$, Fe$^{++}$, Mn$^{++}$, Cr$^{+++}$ and ml. water required for saturation
of per 100 gm. Soils (only at $L_1$ and $L_2$ levels) most of the correlations were found significant.

Correlations failing to reach the level of significance indicated that in saline sodic soils nutritional imbalance are created and their relations are destabilised as stated by Agrawal, (1957, 1958, 1959) and Agarwal et al., (1979a) and others. Agarwal et al., (1979) found $Ws Na^+$ as dominant cation in all different grades of halomorphic soils of Uttar Pradesh and $HCO_3^-$ were found as most frequent and often the dominant soluble anions. Soluble $CO_3^{2-}$ and $HCO_3^-$ ions were found associated with $Cl^-$ and for $SO_4^{2-}$ in conformity with the findings described here. Soluble $CO_3^{2-}$ and $HCO_3^-$ have also been reported by Agarwal and Gupta (1968) to constitute dominant portion of the salty afflorescence at the surface of saline sodic soils that is locally called 'Reh' the term used by Navbold (1946); Middlicot, (1962).

Soils similar in characteristics described as these in Uttar Pradesh have been reported from adjoining states like Bihar, Haryana, Punjab (Agarwal b, Gupta, 1968). Halomorphic soils of other parts of the world also correspond to these soils (Bernstein, 1975) except that these soils also have high proportions of $CO_3^{2-}$. Due to the presence of high $Na^+$ along with high $CO_3^{2-}$ and $HCO_3^-$ ions and saline sodic soils of Haryana, Punjab and Uttar Pradesh. Bhargava et al., (1976) preferred to consider them as a sodic instead of saline sodic soils.
Agarwala et al., (1979) stated that cationic and anionic compositions of SS soils of Uttar Pradesh accounts for several nutritional problems in crops grown on such soils. While some of them are direct effects of high exchangeable sodium with exchange complex and or excessive total soluble salts, others are due to excessive amounts of Na\(^{+}\), CO\(_3\)\(^{-}\), HCO\(_3\)\(^{-}\), Cu\(^{++}\) and SO\(_4\)\(^{-}\) ions which create the toxicities of respective ions or imbalance of essential plant nutrients through pH effects, antagonism, synergism and deficiencies of soluble Na\(^{+}\) and Mg\(^{++}\) ions. To some extent in sodic soils under sullage reclamation high values of water soluble forms of Fe\(^{++}\) and Mn\(^{++}\) as compared to normal soils have been found (Agarwala et al., 1964, 1978, 1979b). With tissue concentrations of Fe and Mn in barley grown on sodic soils of Kanpur and under sullage reclamation, the water soluble forms of the elements have been found under better correlation Agarwala et al., (1978). Solubilization of organic compounds of these elements under sullage conditions have attributed as reason for this.

In conformity with Truog, (1948); Stiles, (1961); Kelley, (1964); Bernstein, (1975); Agarwal et al., (1961, 1979a) concluded that alkaline soils reaction of halomorphic soils of Uttar Pradesh are also conducive to nutrient imbalance in plants grown on such soils because of excessive adsorption of some reduced uptake of other essential and non-essential elements.

Inspite the efforts of Agarwal and Yadav, (1954), 1956a and 1956b); Agarwal and Gupta, (1968); Yadav, (1964-65); Yadav and Mathur, (1962); Yadav and Pathak, (1967); Yadav
and Singh, (1970); Singhala et al., (1974); Pandey and Pathak, (1975); Das and Mehrotra, (1972); Ray Chaudhary et al., (1963); Tripathi and Singh, (1974); and plant nutritional group of Botany Department, Lucknow University; it has been observed by Agarwala et al., (1979a) in agreement with the author that very little information has been made available to help nutritional characterization of halomorphic soils of Uttar Pradesh and their relationships of plants grown on such soils in view of their proper management.

According to Sen and Gupta, (1968) decreased availability of P in saline sodic soils of Uttar Pradesh could be due to reduced phosphate mobility caused by increased activity of sodium in such soils. Agarwala et al., (1979a) stated in many cases that available concentrations of Fe++ and Mn++ in saline sodic soils are low enough to indicate their deficiencies. Reduced availability of Mn++ in sodic soils has been attributed to its high Mn++ retention capacity Mishra and Mishra, (1968).

For Vs (virgin saline sodic soils) the findings described above are in agreement with the observations recorded for this thesis.

In conformity with the findings here Agarwala et al., (1979e) found that soils pH was mainly related to ESP while TSA was also found related to pH. Other components of soil salinity had decreasing effect on soil pH. Other components of soil salinity had decreasing effect on soil pH. SoilESP was also found related to the soil salinity components excluding the TSA.
These reported conclusions were based on total and partial correlation coefficients. They found that as compared to normal soils the sodic soils had lower water soluble contents of $K^+$ and $Ca^{++}$. Water soluble concentration of $Na^+$, $CO_3^{-}$, $HCO_3^-$, $Cl^-$ and $SO_4^{-}$ were found higher in both types of halomorphic soils than normal soils more so in case of saline sodic soils. They explained that higher solubility of nutrient elements in SS soils could be due to dissolution of organic forms of nutrients under $CO_3^{-}$ and $HCO_3^-$ in these soils. Such situation is an accord with Agarwala et al., (1978) also.

In agreement with, the said findings for virgin SS soils author has been also found DE and TE supply negatively related with SS factors of soils affecting plant growth adversely and positively related with essential mineral nutritional factors affecting plant growth favourably. These responses of DE and TE supply have been found more in SS soils than in NSNS soils. With the reduction in sodicity in responses of DE and TE supply the relations, positive or negative between soil factors have been found to stabilize and show highly significant values at $P = 0.01$ levels.

In the results described here in this thesis the DE and TE supply have been found negatively related with soil ESP, E.Ce., $pH$, SAR, $H_2O$ requirews for saturation of 100 gm. Of soils, $Ws CO_3^{-}$, $HCO_3^-$, TSA, $Ws Cl^-$ and $Na^+$ content and positively related with % moisture content in air dry soil, rate of $H_2O$, percolation, % organic matter in soil, $Ws PO_4^{--}$, $SO_4^{--}$, $Ca^{++}$, $K^+$, $Mg^{++}$, $Fe^{++}$, $Mn^{++}$, $Cu^{++}$, $Zn^{++}$ and $Cr^{+++}$. The said
positive correlations may have been also observed because of the content of those elements in the soils in responses to DE supply and TE supply are not in conformity, effluents.

The results presented here showed in soil pH for NSNS with the findings of Pande, (1985); Cooper, (1976); Brieger, (1979) and Rodella et al., who have not tried responses of DE on SS oils. Infact Perez – Escolar, (1979) has observed improvement in properties of saline soils with DE amendments and Singh et al., (1980) has found in laboratory tests that the application of undiluted DE to SS followed by leaching improved the intake of water and decreased soil pH in conformity with the findings here.

In the work presented here infact DE and TE supply was found to reduce soil ESP of SS upto fifty percent. It appears that NH$_4^+$ ions or some other ions present in DE and TE are produced due to dissolution of their increased organic compounds or increased microbial activity and nitrogen fixation or some naturally occurring chelating agents of DE and TE replace the Na$^+$ ions from exchange complex of the soils and make them water soluble to be leached down beyond rooting zone thus reducing soil ESP, Na$^+$ contents of the soils and its uptake by plants and correcting nutritional imbalance created by soil sodicity. In nut shell DE and TE supply appeared to convert SS soils into NSNS soils.

Improvement in soil properties in responses to DE supply has also been observed by Monteiro, (1975); Perez-Escolar, (1979) and Singh et al., (1980) contrary to the findings of
Gautheryron et al., (1970) who found deterioration in soil properties if DE was supplied directly.

Iyer et al., (1957) reported that soils affected by seepage of tannery wastewaters from a tannery near Madras steadily became unfertile and some area of land completely lost productive capacity.

In agreement with Pande, (1985) increasing in Ws Zn$^{++}$ and Cr$^{+++}$ has been observed in the results presented here particularly when chrome tannery effluent was supplied. The increase in Ws Cr$^{+++}$ in DE supplied soils may be due to unavoidable contamination from somewhere.

In the results presented here for petrocrop *P. tithymaloides* L Var. green raised on NSNS soils of Vs remaining NSNS soil (obtained and SS soils of Vs reducing salinity more so sodicity of SS soils.

In the work presented here also plants grown on SS soils have been found to develop nutrient imbalance in accord with the reports of Agarwala et al., (1967); Bernstein, (1975); Hussain et al., (1970); Kelley (1963-64); Mass et al., (1972); Patel and Wallace, (1975). Very limited information is available on the nutrient composition of plants growing on SS soils of India particularly in Uttar Pradesh. Some Eragrostis tenella; Garg and Khanduza, (1976a, 1979b) for paddy, barley and oats.

For chl. a/b ratio, catalase and peroxidase activity and for tissue Na, S, Fe and Cr in plant tops SS soils have been found to show higher values than NSNS soils. For length of stem, dia. of stem, no. of leaves size of leaves, F. M. yield, D. M. yield, chl. a,
On the basis of visual records and analysis Agarwala, (1957, 1958, 1959) concluded that restricted growth plants grown on SS soils are largely due to nutrient, phosphorus, manganese, calcium and at times potassium and copper. Plants grown on such soils showed high sodium, iron and boron into the young and old growth and often molybdenum in younger growth was found low under SS conditions, therefore there is a build up of sodium to calcium and sodium to potassium ratios in plant tissue. His contentions were further strengthened by the favourable responses of plant growth to N, P, K soils amendments. Application of potassium depressed the availability of Na, nitrogen that of P and P that of Mn and Mo. Nitrogen application increased the availability of potassium.

The information gathered on the occurrence of several nutrient disorders of plant in the SS soils of Uttar Pradesh through soil and plant chemical analysis and diagnosis of visual symptoms exhibited by plants grown on such soils have been further confirmed by the crop responses to nutrient amendments. Sharma et al., (1971); Pathak et al., (1975) along with Agarwala et al., (1979a) obtained evidence of Zn responses in SS soils of U.P. Pathak et al., (1978) obtained crop responses to Zn even after treatment of the soils with pyrite. Singh and Pathak (1968) and Singh and Singh, (1975) obtained crop responses to Mn Mukerjee, (1968) obtained responses to Cu application of Fe application. Mishra and Sharma (1967, 1970) reported ameliorative effects of ‘SPARTIN’ a multipurpose micro nutrient fertilizer on barley grown on sodic and SS soils of Allahabad district. These observations also lead to the logical
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lower values of chlorophylls have been found in results presented here in conformity with the findings of Agarwala and Mehrotra (1978).

In the findings reported here ascorbic acid content has been found increase in responses to DE and TE supply in accord with observations of Pande, (1985) who also reported increase in ascorbic acid content in sugar cane leaf in responses to DE and TE supply associated with increase in total carbohydrate and non reducing sugar content of leaves.

Prokoshow and Petrochenko, (1978); Kiryeekhin (1961) and Chinoy (1962) have observed relationship between ascorbic acid content and tissue proteins.

In higher plants AA is known to regulate almost all phases of plant growth. Chinoy, (1962) and Gerg (1966) found AA positively related with peroxidase activity supporting the findings of Bonner (1967) and Maposon and Verlog (1958).

In the results presented here peroxidase activity was found more plants on SS soils than NSNS soils. The peroxidase activity in P. tithymaloides L. var. green has been found positively related with tissue Fe and Ws soil Fe++. The associated of high peroxidase activity with higher tissue Fe and higher Ws soil Fe++ contents supports the findings of Sinha, (1967) and Agarwala et al., (1976, 1979). In agreement with the author for P. tithymaloides L. var. green grown such soils increased peroxidase activity in responses to DE and TE supply has been obtained by Pandey, (1985).
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According to Agarwal et al., (1979e) increase in tissue Na of plants grown on SS soils was mainly due to soil ESP, components of soil salinity other than TSA further enhanced the effects of ESP in this regard, in accord with Agarwala et al., (1979d) and observations recorded here.

In the results presented here Ws soil and tissue Ca was found increased in responses to DE and TE supply more so in DE as compared to TE (chrome). Tissue Ca showed higher values in plants grown on NSNS soils than on SS soils.

According to reports of Agarwala et al., (1979e) tissue Ca of plants grown on SS soils was than that of those grown on NSNS soils in accord with the observations of the author.

In agreement with the findings were Pande, (1985) has found positive relationship of soil and tissue Ca with DE and TE supply.

Ponnia and Bhumbla, (1974) have observed beneficial effect of FYM application on uptake of Ca by barley. ESP has been found to be mainly responsible for depressed tissue Ca. Agarwala et al., (1979e) reported that TSA mitigated the effects of ESP to a great extent. This mitigation was found enhanced in Barley receiving NP fertilization more so in barley receiving N supply. DE and TE supply improved tissue Ca favourably in results presented here.

In the findings presented here plants raised on SS soils showed lower values of tissue K as compared to NSNS soils. These findings are in agreement with Agarwal et al., (1979e) who found that halomorphic soil conditions reduced tissue K.
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phosphorus Olsen et al., 1954) many bring about increase in solubility and availability of P in plants. In accord with this, findings were obtained here in responses to DE and TE supply.

Agarwal et al., have found more tissue S in barley than paddy grown as compared to plants grown on normal soils. Similar findings have been reported earlier by Agarwala et al., (1979d) in case of barley and paddy raised on halomorphic soils of Uttar Pradesh. The increase in tissue S in case of paddy was individually attributed to the salinity components other than TSA and also to ESP of halomorphic soils. Similar results have been recorded here.

Agarwal et al., (199e) have observed NP fertilization in barley to decrease tissue S particularly in normal and sodic soils. Paddy plants showed higher tissue S than barley when grown on SS soils. Here DE as compared to TE has been found to increase Ws soil sulphur as well as as well as tissue sulphur.

Observations of the author recorded enhancement of Ws soil Fe++ and tissue Fe in responses to DE and TE supply respectively. DE has been more effective than TE. Saline sodic soils have been found to show higher values for Ws Fe++ than NSNS soils. Tissue Fe content has been found higher in P. titymoloides L var. green raised on SS soils. Soil ESP, SAR, Ws soil HCO₃⁻ showed negative relations with Ws Fe++ and tissue Fe.

DE and TE supply increased tissue Fe with the decrease in Ws HCo₃⁻, SAR and ESP. the observations recorded are in agreement with Brown et al., (1959a); Wedleigh, (1955);
Decock, (1955a) and Wallace in soil bicarbonate but not in conformity with Pande, (1985); Tandon, (1977); Hale and Wallace, (1960); and Woolhouse, (1966) who observed increase in tissue Fe with enhancement in soil HCO$_3^-$, SAR and ESP.

Agarwala et al., (1979d) have found ESP to decrease and salinity to increase tissue Fe. They found positive relations between ESP and tissue Fe in barley but not in oat. In observation recorded here tissue Fe has been found negatively related with soil ESP in accord with Singh, (1990).

In the results presented here DE and TE supply increased Ws and soil Mn$^{++}$ as well as tissue Mn showing positive relations with Mn content. DE showed more Mn content than TE. P. tithymaloides L.var. green raised on NSNS soils showed higher values for tissue Mn than plants raised on SS soils. Here tissue Mn has been found negatively related with soil ESP, SAR and TSA.

In accord with author Pande, (1985), Singh, (1990) and Srivastava, (1991) reported positive relationships of Mn with DE and TE supply. In agreement with the findings here Tandon, (1977) found decrease in tissue Mn with the increase in soil HCO$_3^-$ in contradiction to the work of Agarwal and Mehrotra, (1982).

Agarwala et al., (1979d) found that decrease in tissue Mn grown on some other halomorphic soils of Uttar Pradesh was due to salinity components other than water soluble CO$_3^{--}$ and HCO$_3^-$.
In the results presented here DE and TE supplies have been found to increase Ws soil Cu$^{++}$ as well as tissue Cu. TE supply has been found to enhance soil and tissue Cu more than DE. Both soil and tissue Cu have been found showing higher values in SS soils as compared to NSNS soils.

In conformity with author Pandey, (1985) has found TE to increase tissue Cu. In TE supplied plants tissue Cu has been found associated with tissue Mg. Struckmeyer and Peterson, (1969) observed that increasing concentrations of Cu was with much greater of Mg in tobacco plants.

In the observations recorded by the author Ws soil Zn$^{++}$ and tissue Zn has been found to increase with the increase in DE in DE and tissue Zn has been found to increase with the increase in DE and TE supply more so in DE and TE supply more so in DE than TE in accord with Srivastava, (1991) and Pande, (1985) who reported DE and TE to increase tissue Zn in sugarcane. Sadbery et al., (1971) observed increase in Zn uptake with the increase in Zn supply.

Author has recorded more tissue Zn content on NSNS soils than raised on SS soils. Zn content showed negative relations with ESP. the associated of tissue Zn with ESP recorded here is not in confirmity with Pande, (1985); Agarwala and Mehrotra, (1982) Bains and Firman, (1964), Agarwala et al., (1977).

In the results presented here it has been that tissue Cr increased with the increase of TE and DE supply. Te (chrome) has been found very marked by more4 Cr content than DE. In plants raised on NSNS soils. TE supply showed positive relations
with Cr content (increase in soil Cr\textsuperscript{+++} has been found to increase in Cr uptake by plants), increase in Ws soil and tissue chromium in response to DE supply appears to be probably due to seepage of chrome tannery effluents which contaminates soils and water up to long distance. In the results presented here distillery effluents have been found to increase tissue Cr from 4.5 ppm (at 35 m\textsuperscript{3}/ha twice irrigated) to 5.75 ppm (at 70 m\textsuperscript{3}/ha twice Cr from 14.25 ppm (at 35m\textsuperscript{3}/ha twice irrigated) to 17.00 ppm (at 70 m\textsuperscript{3}/ha twice irrigated) and tannery effluents have been found to increase tissue Cr from 14.25 ppm (at 35 m\textsuperscript{3}/ha twice irrigated) to 17.00 ppm (at 70 m\textsuperscript{3}/ha twice irrigated) at 75 days growth.

Pande, (1985) found that in TE supplied plants tissue Cr increased from 4.5 ppm (at 17.5 m\textsuperscript{3}/ha) to 5.8 ppm (at 140 m\textsuperscript{3}/ha) at 125 days growth and 4 ppm (at 17.5 m\textsuperscript{3}/ha) to 7.9 ppm (at 140 m\textsuperscript{3}/ha) at 50 days growth. In 315 days growth tissue Cr has been found to increase from 1.8 ppm (at 17.5 m\textsuperscript{3}/ha) to 4.0 ppm (at 140 m\textsuperscript{3}/ha) in case of sugar cane leaves.

Thabaraj et al., (1969) have found that soil pH effect the Cr uptake by plants to a great extent. Scharmer and Schrop (1935) have found very little uptake of tissue Cr in soils with pH more than 4.0.

The increase in tissue Cr with the increase in soil Cr\textsuperscript{+++} is in accordance with the findings of Mishra and Jaiawal (1982) and Carry et al., (1977a). Mishra and Jaiswal, (1982) have observed that Cr beyond 7.5 ppm at 53 days after showing of spinach reduced dry matter yield and plant population.
Finsselo et al., (1976) reported that chromium salt uptake 100 ppm did not effect seed germination of ten crop plants belonging to Gramminae and Leguminosae but Cr$^{6+}$ at 1ppm had a negative effect on growth of *Linum usitatiassimum*.

Soil and tissue Cr in the range observed may prove hazardous for plant growth and animal consumption because 2 ppm or more is reported to be toxic for human consumption. This amount of tissue Cr negates the fertilizer utility of tannery effluents for food and forage crops in agriculture though they have been found to improve plant growth and metabolism and also correct saline sodic soils for fertilizer purposes. In this connection and raising are also important requirement for the future. In case of petrocrop high Cr may not be a health hazard if it does not interfere with the microbial activity of biodigesters.

The results lead to the conclusion that distillary and tannery effluents have fertilizer utility in usar reclamation, if used in proper dozes and dilutions. They convert SS soils into NSNS soils. According to the findings of Sheikh and Irshad, (1980), TE also convert NSNS soils into sodic and saline sodic soils. DE and TE can be of utility in reclaiming usar's (halomorphic soils) covering about 95 million ha of land in the world (Szaboles, 1977), about 7.2 million ha in India (Anonymous, 1976), about 1.3 million ha in Uttar Pradesh (Agarwal and Gupta, 1968) and about 37232 ha in Unnao district alone (Baghel, 1979) and improve growth metabolism and mineral composition of plants growing on such soils. Distillery effluents are more effective in this regard than chrome tannery effluents, which also create high tissue Cr problems.
The levels of DE and TE supply for better plant growth appears to depend on soil type irrigated, plant species raised there on, incubation period, type and quality of DE and TE supplied with or without any amendments, mode and frequency of application etc. in the work presented here 70 m³/ha (twice irrigated level of DE and TE supply has been found better for *P. tithymaloides* L var. green raised on NSNS soils and SS soils in conformity with the findings of Sinha et al., (1986) for barley, Sinha et al., (1989) for barseem and soyabean raised in garden soil under pot culture conditions, Pande, (1985) and Pande and Sinha, (1988) who found better results in case of sugar cane raised normal soils.

Briegar, (1979) observed 35 m³/ha to be a better dose for improvement in growth and yield but Anon, (1979) suggested that application of DE upto 4112 m³/ha through sprinkler and hydraulic gun was found to be usually better than that obtained by the application of mineral fertilizer. Marinbo et al., (1982) reported 135 m³/ha DE without fertilizer improved cane yield and Stupiello and Pexo, (1977) found that with the increase in DE supply upto 210 m³/ha an increase in cane yield was obtained.

The reasons for the increase in the yield of plants in responses to DE and TE supply may be:-

- Improved soil characteristics and soil microbial life.
- Increase in the capacity of cation exchange mainly due to rise in the values of Ca⁺⁺ and Mg⁺⁺.
Increased essential mineral nutrient elements (Ca, K, Mg, P, S, Fe and Mn, Cu, Zn and N as reported by Pandey, (1995), Singh (1990) of soils, their availability and uptake by plants.

Improvement in soil porosity and percolation of water. Improved soil condition reduce soil salinity and ESP.

From the results presented here it may be concluded that SS soils Have values of pH, E.Ce, SAR, CO$_3^{--}$ and HCO$_3^{--}$, TSA, Ws Cl$^-$, and Na$^+$ and low values of essential mineral nutrients such as Po$_4^{--}$, So$_4^{--}$, Ca$^{++}$, K$^+$, Mg$^{++}$, N (air dry soil) Fe$^{++}$, Mn$^{++}$, Cu$^{++}$ and Zn$^{++}$ unfavourable for plant growth more so due to nutritional imbalance. DE and TE rich in organic matter and certain essential nutrient mineral elements when applied with the passage of time or increase in incubation period can reduce SS factors to normal and improve nutrient supply of essential minerals from soil to plants by increasing concentration of the available forms stabilizing relations between soil properties and improving beneficial uptake of minerals in plants for their growth on such soils.

The effects of DE and TE on soils and plants may vary to some extent with the types of soils, plant genotype raised on such soils, level of effluent supply and period of incubation allowed for interaction and microbial activity. DE and TE supply in the range of 35 to 70 m$^3$/ha (twice irrigated) have great fertilizer utility. Chrome tannery effluents may be used for growing sugar cane meant for sugar manufacture during which process the undesirable toxic chromium may be separated
during crystallization, which in itself is a potent procedure for elimination of heavy metals as reported by Pande, (1995).

The utility of these effluents may be found in reclaiming usars required for cultivation of petrocrops accepted to play a very important role in future not very far for meeting energy requirements in view of fast exhausting petroleum reserves. However further investigations are needed in this direction to make better utility of these effluents for the purpose to boost green revolution and counter nasty problems like usurs (saline sodic soils), pollution, unhygienic health hazards, loss of minerals and waters to Oceanside. In the interest of Man, plant and animal life all over the globe by biological recycling of ever increasing distillery and tannery effluents on the earth with fast modernising world and deteriorating environmental conditions edaphic, hydric and atmospheric.

*Calotropis procera* L. Family Asclepiadaceae, commonly known as milkweed or swallow-Wort, is a common waste land weed (Singh et al., 1996). *Calotropis* belongs to Asclepiadacoae or milk weed Cr AK family which includes 280 genera and 2000 species of world-wide distribution but most abundant in the sub-tropics and tropics, is native to India (Lindley, 1985): Calotropis grows wild up to 900 meters thought the country (Sastry and Kavathekar, 1990) on a variety of soils in different climates, sometimes where nothing else grows.

Calotropis is used as a traditional medicinal plant (Rastogi and Mehrotra, 1991), Qudhia and Dixit, (1994); Qudhia, (1999a, b, c, d) with the unique properties Qudhia and Tripathi, (1998, 1999a). Traditional.
Alotropis is used alone or with other medicinals (Coius, 1986) to treat common disease such as fevers, rheumatism, indigestion, cough, cold, eczema, asthma, elephantiasis, nausea, Vomiting, diarrhea (Das 1996). According to Ayurveda, dried root bark as a substitute for ipecacuantha. The root bark is febrifuge, anthelmintic, depurative, expectorant and laxative. The powdered root used in asthma, bronchitis and dyspepsia. The leaves are useful in the treatment of paralysis, arthalgia, swelling and intermittent fevers. The flowers are bitter, digestive, astringent, stomachic, anthelmintic and tonic (Agharkar, 1991; Warrier et al., 1996). Calotropis is also a reputed homoeopathic drug (Ghosh, 1988; Ferrington, 1990).

Calotropis yields durable fibre (commercially known as bowsstring of India) useful for ropes, carpets, fishing nets and sewing thread. Floss, obtained from seeds, is used for stuffing purposes. Fermented mixture of Calotropis and salt is used to remove the hair from goat skins for production of “Nari leather” and of sheepskins to make leather which is much used for inexpensive book binding (Singh et al., 1996). Fungicidal and insecticidal properties of Calotropis have been reported (Ganapathy and Narayana Samy, 1993).

Allelopathic effects of Calotropis on different agricultural crops have not been well studied extracts of different plant parts viz. Root, stem, leaf and stomtle leaf of Calotropis effect germination and seedling vigor of many agricultural crops have been reported (Qudhia and Tripathi, 1997, 1999; Qudhia et al, 1997, 1998 a, b). However, extracts of Calotropis failed to produce any detrimental effects on weeds such as Chenopodium
album, Melilotus alba, Melilotus indica, Sphaeranthus indicus and Phalaris minor (Qudhia and Tripathi, 1997).

A yellow bitter resin; a black acid resin; Madaralbum, a crystalline colourless substance; Madarfluavil, an amber coloured viscid substance and caoutchouc, and a peculiar principle which gelatinizes on being heated, called mudarine, Lewin found a neutral principle, Calotropin a very active poison of the digitalis type. In India it is used in papermaking. The arid juice hardens into a substance like gutta-purcha. It has long been used in India for abortive and suicidal purposes. Mudar root-bark is very largely used there as a treatment for diarrhea and dysentery. As an antodote to poisoning atropine may be administered. In severe cases the stomach pump may be used and chloral or chloroform administered. Amyl nitrite may also be useful.

The latex is poisonous, containing digitalis like compounds that effect the heart and is used to make arrow passion. Medicinally the acrid sap latex is used to treat boils, infected wounds and other skin problems in people, and to treat parasitic skin infestations in animals. It also yields ash for making gunpowder and extreme strong fiber.

A major amount of energy rich biocrude was obtained from different solvent extracts as evidence by their high Calorific values like 15460, 11286, 10708 cal/g. for PEE, BENE and EAE, respectively.

The experimental plant possesses an appriciably superior full malityas compared to Calotropis procera which (Erdman and
The Per and BENR can also compete with conventional energy sources like wheat straw, rice straw and wood.

*Pedilanthus titymaloides* was evaluated as an incessantly renewable and potential source of hydrocarbons. Extracts were obtained from successive extraction of whole plant material with solvents like petroleum ether (b.p. 60-80°C), benzene (b.p. 80°C) and ethyl acetate (b.p. 76-78°C). A white amorphous mixture of hydrocarbons was obtained by elution of the column by petroleum ether (b.p. 60-80°C), which was found to be comparable with gasoline.

Modern society depends very much upon fossil fuels, total oils resources are being depleted, and their spare of total energy supply is predicted to fall to 10% by the year 2020. To meet this acute shortage the technology aimed at the utilization of renewable energy that can serve to replace fossil hydrocarbons needs to be expanded. *Calvin* (1977) reported that latex-bearing plants are the most obvious alternative renewable source of fuel and chemical feed stock. It was seen that some higher plants can convert the initially produced carbohydrate into terpenes instead of into fatty acids and glycerides such as seed oil *Calvin*, (1982) has considered *Euphariba lathyris* L. to be a kind of "energy farm" capable of producing a mixture of reduced terpenoides which can be converted to gasoline-like substance. The most interesting and attractive species is *Capaifera multijuga* oil) that is obtained from its heartwood by tapping (Alencar, 1982). A single hole through the stem may yield about
25 liters of oil in 24 hours a ready made engine oil (Calvin, 1982).

It is true that the economic development of plant hydrocarbons will ultimately depend upon agronomy and conversion cost (Weisz and Marshall, 1979). Pedilanthus tithymaloides Poit, which grows profusely in marginal wasteland in northern and eastern India without any agricultural management, was undertaken to evaluate the hydrocarbons content and its potential use as a petrocrop.

About 500 g of milled sample was extracted in a soxhlet apparatus first with petroleum ether (Mercl, India Ltd., b.p. 60-80°C) then benzene acetate (95% s.d. fine chemicals India Ltd. b.p. 76-80°C). All the extracts were concentrated through distillation at a temperature 50°C above the boiling point. The extracts were dried at 600°C for 24 hours then weighed for yield per g of dry sample. The plant residue after each solvent extraction was completely air dried before the next solvent extraction.

The unextracted milled whole plant sample, different solvent extracts, and their residues after each extraction were analyzed for total ash content by the AOAC method (1975). Gross heat values of EAE were 0.11.