

5. SUMMARY AND CONCLUSION



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The present investigation deals with the effect of pulp and papermill (HNL Velloor, Kerala) effluent on seed germination, growth of the seedlings, morphological characters like length of the stem, length of the root and the number of leaves, phytomass and productivity, yield (number of flowers, number of fruits and dry weight of fruits), chlorophyll and carotenoid content, carbohydrate and protein content and SEM studies of the seeds of four economically important plants (Abelmoschus esculentus, (L.), Moench, Cucumis sativus, L., Lycopersicum esculentum, Mill. and Sesamum indicum, L.).

Four dilutions (25%, 50%, 75%, and 100%) of the effluent were employed for the study. The physico-chemical analysis of the effluent shows that it was alkaline (pH 9.24), with high BOD 5 day at 20°C (187.00 mg/l) and COD (400.00 mg/l), low dissolved oxygen (1.2 mg/l) and a chloride content of 125.96 mg/l and sodium content of 510.00 mg/l which increased the salinity. The potassium content was 70 mg/l. High amounts of nitrate (90.00



mg/l), nitrate (4.60 mg/l) and phosphate (8.5 mg/l) were found in the effluent. The total, suspended and dissolved solids present in the effluent were 330 mg/l, 20 mg/l and 300 mg/l respectively. No trace of Hg was found.

The seeds of all the four plants treated with 25% effluent showed an increase in germination percentage. The higher concentrations (50%, 75%, and 100%) however proved to be detrimental to seed germination. All the plants under study exhibited maximum inhibition in germination with 100% effluent. The radicle and hypocotyl elongation was also affected positively in 25% effluent dilution, except in *A. esculentus*, (L.) Moench and *C. sativus*, L.. In 50%, 75% and 100% effluent concentrations the radicle and hypocotyl length were decreased in all the four plants studied.

A deleterious effect was noted in the stomatal index and stomatal frequencies of the cotyledonary leaves of the seedlings grown in different dilutions of the effluent. All the four concentrations had a negative impact on these characters.

The chlorophyll and carotenoid contents of the cotyledons as well as mature leaves showed an increased value in 25% effluent dilution except in the cotyledons of *A. esculentus* (L.) Moench and *S. indicum*, L.. In these plants, the 25% effluent concentration had produced a negative effect. The 50%, 75% and 100% effluent had decreased the pigment content considerably. But in *C. sativus*, L. and *L. esculentum*, Mill. the 50% effluent concentration had caused an increase in the pigment content of cotyledons. In mature plants, all the higher concentrations (50%, 75% and 100%) were found to be deleterious to pigment content.



Different dilutions of the effluent changed the morphological characters (length of the stem and root and the number of leaves) in different intensities. The 25% effluent treatment was found to be beneficial for the stem and root growth and also the number of leaves. The 50%, 75% and 100% effluent treated plants showed a decrease in their stem and root length. The 100% effluent was found to be the most harmful one. These results were observed in all the experimental plants.

Stomatal index and stomatal frequency of the mature leaves showed an increase in 25% effluent concentration whereas in 50%, 75% and 100% effluent, the values showed considerable reduction compared to the control. All the four plants showed similar results.

The phytomass (stem, root, leaf and total) and productivity of the plants showed considerable reduction in higher concentrations of the effluent (50%, 75% and 100%). The 25% effluent was found to be beneficial for the phytomass and productivity.

Yield studies showed that the number of flowers, number of fruits and dry weight of fruits of the 25% effluent treated plants had an increase whereas in higher concentrations (50%, 75% and 100%) these characters showed a reduction.

Scanning electron micrographical studies of the seeds in the control and the 100% effluent treatment were done. The seeds of A. esculentus, (L.) Moench and L. esculentum, Mill. treated with the effluent showed some changes in the ornamentations of seed coat. The other two plants showed no much variation from the control.



The histochemical localization of metabolites (insoluble and sulphated and carboxylated polysaccharides, starch and total proteins) were qualitatively analysed by different histochemical stains. Studies were conducted only in the control and 100% effluent treated plants. The intensity of the staining was less in 100% effluent treated plants compared to the control plants.

In quantitative analysis, the carbohydrate and protein contents of the plants treated with 25% effluent showed some increase. The 50%, 75% and 100% effluent concentrations produced a deleterious effect on the carbohydrate and protein contents. All the studied plants showed similar results.

The plants considered for the present investigations are very important as they play a major role in the economy of the country. Three of them- A. esculentus, (L.) Moench, C. sativus L. and L. esculentum, Mill. are used as vegetables and S. indicum, L. is one of the important oil seeds. Though it is proved beyond doubt that lower concentrations of the effluent can enhance plant growth, the actual concentration of the effluent found in the nearby river is well beyond the tolerance limit and this will certainly prove harmful for the normal life of the plants irrigated with the river water. When the growth is affected, the yield of the plants will fall below the normal production line and thus the economic scenario of the country may become dull. This disaster may be caused by almost all the industrial units. Therefore extreme care should be exercised to see that the industrial effluents are properly diluted and made safe before they are discharged into the environment.

