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Original Research Paper

Ipomoea carnea Jacq. for Immobilization of Solid Wastes

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ABSTRACT

Ipomoea carnea Jacq. (Family: Convolvulaceae) is an exotic weed distributed in tropical countries of Asia and America. In India, it is a common weed in the fields and has probably got introduced along with cultivation. General survey of vegetation showed that this species formed pure or mixed stands in practically all kinds of habitats common in an urban environment, revealing its wide ecological amplitude. Systematic study was undertaken to assess the range of tolerance of this species to various environmental stresses. Present paper reports the response of *Ipomoea carnea* to solid wastes containing heavy metals like copper. The morphological form of the plant, with very strong horizontal suckers, helps in its firm anchorage in different types of soils. This property and its natural assets, preventing its harvesting or grazing, are useful in its profuse growth on wastelands. Organic waste in soil helps in increasing its growth, in spite of the soil containing heavy metals like copper. Its capacity for gregarious growth at various unfavourable habitats is a pointer for its possible utility in greening such habitats which keep increasing with urbanization and industrialization.

INTRODUCTION

Solid wastes, natural or man-made, have been a problem for man since a very long time. With the progress of industrialization, there has been a great addition to the production of solid waste materials from industrial, commercial, domestic, agricultural and mineral exploration processes (Anon 1976). Most of the solid wastes, when not disposed off properly or when dumped in open spaces lead to air and water contamination of the neighbouring areas endangering stock and people (Jones & Howells 1975). They also cause changes in natural ecosystems.

The wastes have detrimental effects on the important components of nature, viz., air, water and soil. These in turn have adverse effects on biotic components like microorganisms, plants, animals and human beings. The problems arise out of improper and faulty ways of disposal of solid wastes.

Following are the ways in which the wastes behave giving rise to environmental concern.

1. Water pollution due to leaching and erosion by water, of chlorinated hydrocarbons, sulphur compounds and heavy metals.
2. Open dumping leads to air pollution due to presence of volatile short chained fatty acids releasing CO_2, CH_4, NH_3, H_2S, etc.
3. Land pollution due to changes in soil characteristics like pH, e.g., acidic due to S-compounds or alkaline due to wastes like $CuSO_4$, ammonical compounds, etc.
4. The metalliferous wastes are added to soil through different industrial as well as mineral wastes. Many waste products from mining activities are contaminated with metals at toxic levels and produce large scale pollution. Unproductive ore, tailings and seepage regularly contaminate mining areas. Smelting of ore produces contaminated slag and smoke fumes carry contamination over large distances (Antonovics et al. 1971). The metalliferous wastes often contain concentra-

tions of toxic materials high enough to prevent or restrict plant growth. They are very deficient in nitrogen and phosphorus content and other micronutrients (Smith & Bradshaw 1979). Since they lack vegetation cover, the wastes are quite liable to erosion by wind and water, consequently polluting neighbouring land and water, sometimes, endangering stock and people (Jones & Howells 1975). Solids dumped into ocean can create "dead zones" where neither plants nor animals can survive.

The paper deals with the study of growth performance of *Ipomoea carnea*, when grown in different levels of wastes containing copper and soil. Solid waste was collected from an industrial area near Thane and contained copper at 2.672 µg/g.

MATERIALS AND METHODS

Experiment-I: Growth of *Ipomoea carnea* in soil and waste material mixed in different proportions as follows:

	Soil	*Waste*
i)	100%	-
ii)	75%	25%
iii)	50%	50%
iv)	25%	75%
v)	-	100%

The quantities of waste and soil were measured by weight and mixed thoroughly before filling the pots.

Experiment-II: This experiment was exactly as the previous one except that the soil contained FYM in proportion of 1:3. Waste material was added to this soil in the following ratios.

	Soil + FYM	*Waste*
i)	100%	-
ii)	75%	25%
iii)	50%	50%
iv)	25%	75%
v)	-	100%

Plants were grown and harvested on 61st day in both the experiments. Shoot length, shoot diameter, area of 5th leaf from top, shoot dry weight and mean growth performance (M.G.P.) were estimated.

RESULTS AND DISCUSSION

Experiment-I: The results are shown in Tables 1, 2 and Figs. 1, 2, 3. The plants in control and mixture containing 50% solid waste showed maximum shoot length, while in other mixtures a reduction in shoot length was noticed. The values of shoot length were: control-33.93 cm, 25% waste-33.2 cm, 50% waste-33.93 cm, 75% waste-24.53 cm and 100% waste-19.13 cm.

Shoot diameter was maximum in control and the mixture containing 25% waste, while in others it decreased. Area of the 5th leaf was highest in control, whereas plants in other mixtures showed lower values.

Dry matter production per shoot was highest in the control set, but with increasing levels of the

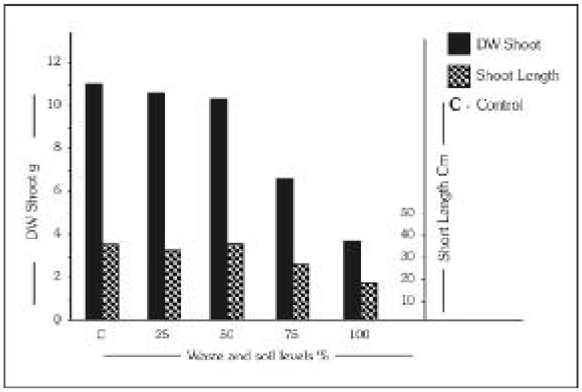

Fig. 1: Length and dry weight of shoot of 60-day old plants of *Ipomoea carnea* grown in different proportions of solid waste and soil.

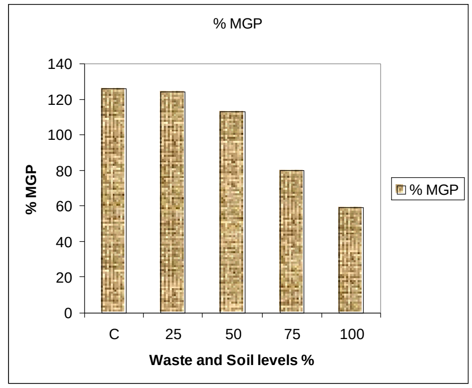

Fig. 2: Percentage MGP per plant of 60-day old plants of *Ipomoea carnea* grown in different proportions of solid waste and soil.

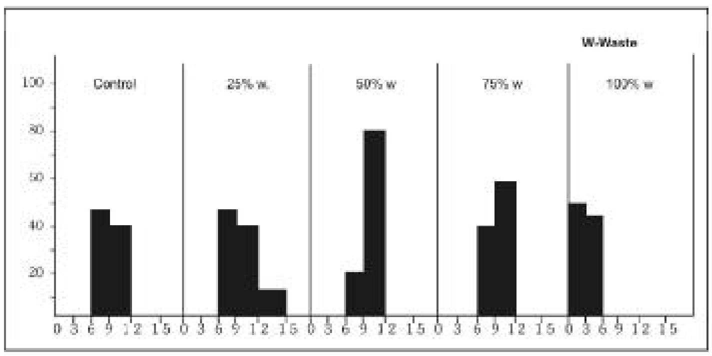

Fig. 3: Percentage frequency distribution diagrams of shoot dry weight in g of *Ipomoea carnea* grown in different proportions of solid waste and soil.

waste, it decreased. The values of dry matter production were 10.91 g in control, 10.46 g in 25% waste, 10.2 g in 50% waste, 6.86 g in 75% waste and only 3.98 g in 100% waste.

Mean growth performance (M.G.P.) was good in control, 25% and 50% waste, while poor in the plants grown in 75% and 100% waste.

Experiment-II: The results are shown in Tables 3, 4 and Figs. 4, 5, 6. Growth of *Ipomoea carnea* was better in the pots containing soil with FYM compared to those containing only waste.

Values of shoot length noticed in plants growing in the waste were: 25% waste-61.8 cm, 50% waste-61.63 cm, 75% waste-49.6 cm, 100% waste-19.13 cm.

Shoot diameter was maximum in control plants but reduced with increasing levels of waste material. Leaf areas of 5th leaf also showed a similar trend.

The shoot phytomass per plant was highest in control and 25% waste. The values of shoot mass were 13.49 g in control and 25% waste, 13.29 g in 50% waste, 8.82 g in 75% waste, and 3.98 g in 100% waste.

M.G.P. was good in control, 25% waste and 50% waste, while in 75% and 100% waste, it was

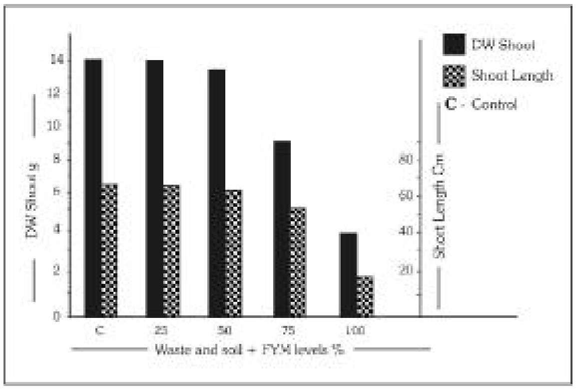

Fig. 4: Length and dry weight of shoot of 60 day old plants of *Ipomoea carnea* grown in different proportions of solid waste and FYM with soil.

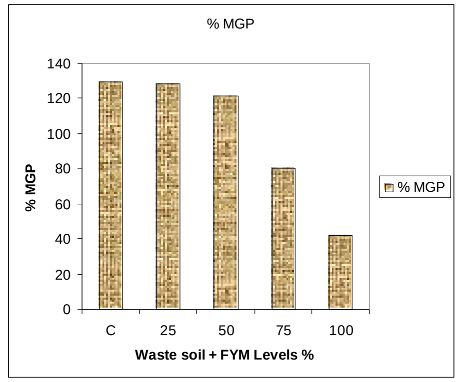

Fig. 5: Percentage MGP per plant of 60-day old plants of *Ipomoea carnea* grown in different levels of solid waste and FYM with soil.

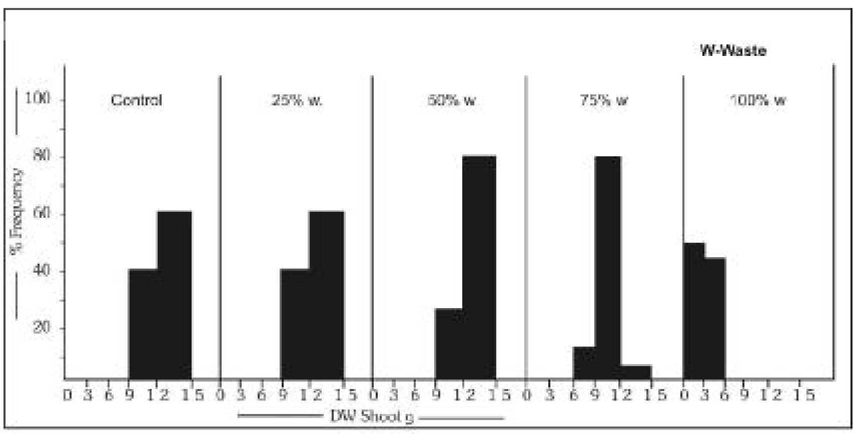

Fig. 6: Percentage frequency distribution diagrams of shoot dry weight in g of *Ipomoea carnea* grown in different proportions of solid waste and FYM with soil.

poor.

It was also noticed that, in general, that the addition of FYM helped growth of plants, irrespective of toxicity of wastes. On comparing results obtained in the experiment-I with II, it was noticed that plants showed better growth performance, when grown in different levels of soil with FYM and wastes than when grown in soils alone without F.Y.M.

The results presented in this paper revealed that growth of *Ipomoea carnea* was affected adversely in the presence of copper-contained industrial waste. The ill-effects were perceptible in the form of reduction in shoot mass, whether the wastes were present at farming horizons (layers) in soil or as diffused material in differing proportions in soil. Invariably, addition of organic matter to the soil, helped in reduction of toxicity of wastes and to plant production processes, most probably due to the property of organic matter to adsorb and mitigate toxicity of metals.

CONCLUSIONS

Table 1: Growth performance and primary production of 60-day old plants of *Ipomoea carnea* grown in different levels of solid waste and soil. (Mean of 15 observations ± SEM).

Percentage of solid waste in soil	Shoot length in cm	Shoot diameter in cm	Area of 5th leaf in cm^2	Shoot dry weight in g
0%	33.93 ± 1.37	0.58 ± 0.03	36.16 ± 0.63	10.91 ± 0.47
25%	33.20 ± 1.15	0.58 ± 2.35	36.05 ± 0.66	10.46 ± 0.36
50%	33.93 ± 1.36	0.55 ± 2.61	27.07 ± 0.91	10.20 ± 0.14
75%	24.53 ± 0.19	0.50 ± 0.06	14.01 ± 0.36	6.86 ± 0.21
100%	19.13 ± 0.23	0.43 ± 0.05	10.29 ± 0.55	3.98 ± 0.22

Table 2: Percentage of each growth parameter per plant of 60-day old plants of *Ipomoea carnea* grown in different levels of solid waste and soil (percentage of each growth parameter calculated by taking the respective general mean-100%).

Percentage of solid waste in soil	Shoot length in cm	Shoot diameter in cm	Area of 5th leaf in cm^2	Shoot dry weight in g	Mean growth performance (MGP)	Rating of growth*
Control (red-loam)	117.34	111.53	146.33	128.65	125.96	Good
25%	114.72	111.53	145.89	123.34	123.87	Good
50%	117.34	105.76	109.55	120.28	113.23	Good
75%	84.76	96.15	56.69	80.89	79.62	Poor
100%	66.11	82.92	41.31	46.93	59.31	Poor

Rating classes = < 90% = Poor, 91-100% = Low average, 101-110% = High average, > 110% = Good

Table 3: Growth performance and primary production of 60-day old plants of *Ipomoea carnea* grown in different levels of solid wastes and organic manure with soil (Mean of 15 observations ± SEM).

Percentage of solid waste in mixture of organic manure soil	Shoot length in cm	Shoot diameter in cm	Area of 5th leaf in cm^2	Shoot dry weight in g
Control (75% FYM)	62.20 ± 0.07	0.73 ± 0.07	65.85 ± 1.57	13.49 ± 0.24
25%	61.80 ± 0.76	0.72 ± 0.02	64.78 ± 1.52	13.49 ± 0.25
50%	61.53 ± 0.89	0.69 ± 0.03	55.09 ± 2.06	13.29 ± 0.19
75%	49.60 ± 0.13	0.51 ± 0.03	24.91 ± 1.38	8.82 ± 0.31
100%	19.13 ± 0.23	0.43 ± 0.05	10.29 ± 0.55	3.98 ± 0.22

Table 4: Percentage of each growth parameter per plant of 60-day old plants of *Ipomoea carnea* grown in different levels of solid waste and organic manure with soil (Percentage of each growth parameter calculated by taking respective general mean-100%).

Percentage of solid waste in mixture of organic manure + soil	Shoot length in cm	Shoot diameter in cm	Area of 5th leaf in cm^2	Shoot dry weight in g (MGP)	Mean growth performance	Rating of growth*
Control(75% FYM)	122.32	119.67	149.04	127.14	129.54	Good
25%	121.53	118.03	146.62	127.14	128.33	Good
50%	121.00	113.11	124.69	125.25	121.01	Good
75%	97.54	83.60	56.38	83.12	80.16	Poor
100%	37.62	70.49	23.29	37.51	42.22	Poor

*Rating classes = < 90% = Poor, 91-100% = Low average, 101-110% = High average, > 110% = Good

The observation has great significance in planning processes for restoration of wastelands.

- *Ipomoea carnea* Jacq. can be one of the potential species to restore the wasteland and in turn to check soil erosion as it can grow in varied type of soils including the polluted soil.
- Recycling of solid waste is a problem in metropolitan cities like Mumbai. There are many dumping grounds all over Mumbai, which create a nuisance to residents as many of them are situated within the city limit causing pollution. Plantation of *Ipomoea carnea* in such areas can provide a positive step towards overcoming the solid waste pollution, mainly heavy metal pollution from solid wastes.
- Aesthetically too, this plant can be considered for plantation to create a green belt on waste and polluted lands. It has beautiful purple coloured flowers, which are in bloom almost throughout the year.
- Some other species like *Alternanthera* sp., etc., which are growing abundantly, can be tried out on experimental basis for such purposes.

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