RESPONSE OF WATER HYACINTH MANURE ON GROWTH ATTRIBUTES AND YIELD IN BRASSICA JUNCEA

Nuka LATA[1], Dubey VEENAPANI

Department of Botany, C.M.D. P.G. College, Gurughasi Das Vishwavidyalaya Bilaspur (C.G.) India
Phone: 00971506302316, Email: lata_c1@yahoo.com

ABSTRACT

Field experiment was conducted during 2007 and 2008 to study the effect of water hyacinth manure in comparison to control on *Brassica Juncea (Indian mustard)*. Soil mineral analysis test was carried out for soil sample types. Added organic matter, water hyacinth manure in various combinations into soil has been found to influence the performance of crop plants as a result of the increase in nutrient availability. The observations revealed positive response with 100% water hyacinth manure, 50% water hyacinth manure and water hyacinth manure combined with farm yard manure on the growth behaviour of seedlings as they were enhanced significantly compared with that of the seedlings grown in control. The growth of *Brassica Juncea* was more pronounced with 50% water hyacinth manure and productivity with 100% water hyacinth manure treatment.

Keywords: Brassica Juncea, Eichhornia crassipes, Manure, Water hyacinth, Yield

INTRODUCTION

One largely overlooked resource available for soil fertility remediation is the use of non-traditional organic materials such as weeds. The use of decayed tissues of unwanted plants to provide nutrients for crops is a crude but effective way of exploiting weeds and is a simpler technique than any of the other alternatives available. The use of non traditional organic resources such as weeds for soil fertility improvement purposes has been studied by Sonke [27], Gachengo [7], Jama *et al.* [13], Nziguheba *et al.* [22] and Chukwuka and Omotayo [3]. According to Beckman [2] the use of manure application enhances soil productivity, increases the soil organic carbon content, soil micro-organisms, improves soil crumb structure, the nutrient status of the soil and enhances crop yield. Organic manure is also very cheap and effective as a good source of nitrogen for sustainable crop production, but its availability remains an important issue due to its bulky nature, while inorganic fertilizer is no longer within the reach of poor-resource farmers due to its high cost [25].

Eichhornia crassipes (Mart.) Solms-Laubach commonly known as water hyacinth belonging to the family Pontederiaceae is listed as one of the most productive plants on the earth and is considered the world's worst aquatic weed [11, 30, 8]. Its habitat

ranges from tropical desert to subtropical or warm temperate desert to rainforest zones. It tolerates annual temperatures ranging from 21.1°C to 27.2°C and its pH tolerance is estimated at 5.0 to 7.5. The 'beautiful blue devil' water hyacinth, recognized by its lavender flowers and shinning bright leaves is a prolific aquatic plant, which spreads at an alarming rate. The plant is euryhaline, tolerating both fresh and marine water; hence its spread knows no boundaries. The so called "menace and nuisance" has tremendous potentiality of high rates of vegetative growth [24]. This macrophyte is one of the most invasive aquatic weeds in the world [29, 15] causing a serious hindrance to nations development activities. The plant is now considered as a serious threat to biodiversity. The possible ways of combating its proliferation and the various methods of eradicating this "weed" not proved much. All the efforts were in vein. Hence the present investigation aims towards the exploration of "best out of waste". Thus its utilization may become a way of its management.

Day [6] described the manorial value of water hyacinth especially in regard to its potash content, which is particularly high in the stalks. Singh and Yadav [26] also proved that different composts prepared from water hyacinth, mixed weeds, dry leaves and berseem increased yields of wheat, green beans and rice. This study was therefore carried out with the aim of finding the effect of water hyacinth manure on the production of the crop plant *Brassica Juncea* commonly known as Indian mustard. The investigation conducted to assess the positive effects of water hyacinth manure on crop yield and also to recommend an economical and feasible technology for farmers.

MATERIALS AND METHOD

An experiment was conducted at the field laboratory of the Department of Botany, CMDPG College, Bilaspur, India during the period of July to October 2007 and 2008. The general climate of the area is wet and humid, experiences hot summer and moderately cold winters, interspersed with rainy months. The annual potential evapo-transpiration is slightly higher than the annual rainfall. The monsoons are heavy between July and September in this region.

Experimental design and treatments

Water hyacinth manure was prepared during the rainy season at the campus (took 3 months and 10 days for the conversion of water hyacinth in to manure). Thus, obtained WHM (water hyacinth manure) was taken in varying combination such as 100%WHM (whole water hyacinth manure, 1:0), 50%WHM (water hyacinth manure + garden soil, 1:1), FYM'W (water hyacinth manure + farm yard manure in the ratio of 1:3) and CNTR (control where no water hyacinth manure but only garden soil is taken, 0:1). Soil mineral analysis test was carried out for soil sample types. Soil pH was taken using digital pH meter. Soil organic carbon was determined by the Walkley Black Modified method, while Ca, Mg, K, P, Na, Mn, Cu, Zn and Fe were determined by the Mehlich-3 extraction procedure [19]. Total nitrogen was analyzed by the

Technicon AA II method [12]. Chemical composition of soil types are shown in table 1 and 2.

The seeds of *Brassica Juncea* were collected from the local market of Bilaspur. Only sound seeds were used to run the experiments. The selection of sound seeds was based on different morphological criteria such as colour, size and being uninfected. Seeds of test plant were sown equidistantly at the rate of 15 plants/labeled polythene bags of equal size and volume, filled with different soil treatments and were well perforated for aeration.

Weather conditions and measurement of plant parameters

The seeds of *Brassica Juncea* were grown from July to October under atmospheric conditions with maximum and minimum temperature values 32.3 and 18.9^{o}C respectively with relative humidity value of 85% within the study period. Annual rainfall range was between 984.8 and 1310.8 mm. At maturity, a number of parameters were used to measure and evaluate the growth of *Brassica Juncea* seedlings under different treatments [20]. These parameters include length of shoot, length of root, length of whole plant, number of inflorescence/plant, number of seeds/ plant, fresh weight and dry weight of shoot, fresh weight and dry weight of root, dry weight of pod, shoot/root ratio on fresh and dry weight basis.

Statistical assessment

The experiments were repeated twice with three replicates. The data obtained were subjected to statistical analysis. Observations were presented in tabular form representing the Mean ± SD.

RESULTS

Physiological behaviour of *Brassica Juncea* when grown in different soil combinations were presented in the table 3. Application of all combinations of water hyacinth manure had significant influence on the growth attributes and yield of the test plant when compared to control. A perusal of the data from table 3 reveals that the maximum increase in yield biomass was observed in 100% WHM treatment. The plants grown in 100% WHM showed higher values in number of inflorescence/ plants, number of seeds/plant, f. wt. of root, d. wt. of root and d. wt. of pod than the plants treated with 50% WHM, FYM'W & CNTR. Likewise the plants grown in 50% WHM showed higher values in length of shoot, length of root, length of whole plant, f. wt. shoot & d. wt. of shoot over the plants treated with other combinations of soil. WHM (Water hyacinth manure) enhanced the yield (on the basis of d.wt. of pod) of test plant *Brassica juncea* by 89.02%. The plant showed best growth attributes with 50% WHM and yield performance with 100% WHM treatment and may be arranged in the order as 100% WHM>50%WHM>FYM'W>CNTR.

Table 1. Mineral composition of experimental soil

	Control Soil (CNTR)	Water hyacinth manure (WHM)
pH	7.4	7.8
Total Nitrogen (%)	0.161	0.86
Available Phosphorous (ppm)	55.82	98.64
Potassium (C mol Kg-1)	1.18	2.96
Organic Carbon (%)	3.39	4.42
Ca (C mol Kg-1)	30.72	49.79
Mg (C mol Kg-1)	3.05	6.88
Na (C mol Kg-1)	0.61	1.06
Zn (ppm)	2.71	3.21
Cu (ppm)	3.04	3.26
Mn (ppm)	231.78	272.54
Fe (ppm)	115.96	115.72

Table 2: Chemical composition of Farm Yard Manure (FYM)

Composition	Values (%)
Total Nitrogen	0.51
Available Phosphorous	0.26
Potassium	0.30
Calcium	0.20

DISCUSSION

Efforts at remediating soil fertility over the years have basically been achieved using traditional resources of farmyard manure and crop residues in composted forms as well as use of inorganic fertilizer [28]. Weed however; have been recognized to have significant effects on sustainability of soil nutrient resources and yield of agricultural produce [23]. The benefit of using either crop residues such as water hyacinth residues has been reported by Widjajanto *et al.* [31, 32]. The study of water hyacinth as biofertilizer revealed that the incorporation of water hyacinth into soil crop system increased the performance yield of the crop plant *Brassica juncea.* Water hyacinth manure (WHM) in all combinations was found to be more effective for the growth and yield of the test plant over the control. Majid [16] have reported enhancement in yield/plant in rice, corn, sesame, brinjal, onion and gourd, using water hyacinth compost. Majid *et al.* [18] & Majid [17] reported the increased yield in above plants with both compost as well as manure of water hyacinth used in combination with other aquatic weeds. Our results are in agreement with previous

works [21, 10, 31]. Widjajanto *et al.* [33] reported the increased performance of *Brassica rapa* by the incorporation of water hyacinth into soil-crop systems. Gunnarssen & Petersen [9] also highlighted that using composted water hyacinth material could serve as quality manure for improving soil fertility conditions and thus crop yields on the whole. Enhanced affects of water hyacinth have been reported by Kayum *et al.* [14] on productivity of tomato and Amitava *et al.* [1] on rice. Chukwuka & Omotayo [3, 4] indicated the soil fertility potential of water hyacinth compost and revealed its enhanced affect on productivity of *Zea mays* crop. With this result it can be suggested that, by the addition of water hyacinth manure into cultivation which affected the performance of test plant may be probably due to the increase of Nitrogen availability released from water hyacinth during the process of mineralization. This is in agreement with Contantinides & Fownes [5] who mentioned that quality and quantity of added organic materials into soil may influence the decomposition rate and mineralization process. The same phenomenon was also reported by Widjajanto *et al.* [31].

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Table 3: Growth parameters of Brassica Juncea (Indian mustard) grown under different combinations of WHM.

S.No.	Growth parameters	100% WHM	50% WHM	FYM'W	CNTR
1	Length of shoot (cm)	23.833 + 1.689	31.4 + 3.226	20.933 + 2.632	16.366 + 2.373
2	Length of root (cm)	11.020 + 0.958	11.1 + 1.846	10.067 + 1.114	8.134 + 0.503
3	Length of whole plant (cm)	34.866 + 1.590	42.5 + 5.930	31 + 2.968	24.5 + 5.033
4	No. of inflorescence/plant	15.333 + 1.901	13.333 + 1.901	14.666 + 4.304	6.666 + 0.950
5	No. of seeds/ plant	95.329 ± 2.974	49.606 ± 2.041	78.098 ± 4.947	38 ± 0.448
6	F.wt. of shoot (mg)	0.6 + 0.168	0.763 + 0.166	0.573 + 0.181	0.271 + 0.054
7	D.wt. of shoot (mg)	0.215 + 0.065	0.371 + 0.087	0.22 + 0.092	0.113 + 0.032
8	F.wt. of root (mg)	0.15 + 0.049	0.075 + 0.041	0.111 + 0.040	0.041 + 0.003
9	D.wt. of root (mg)	0.055 + 0.037	0.041 + 0.017	0.045 + 0.019	0.011 + 0.003
10	D.wt. of pod (mg)	0.337 + 0.012	0.23 + 0.042	0.104 + 0.078	0.037 + 0.008
11	S/R ratio (F.wt. basis)	4	10.17	5.16	6.60
12	S/R ratio (D.wt. basis)	3.90	9.04	4.88	10.27

[Mean + S.D. (n = 60)]

Key : WHM = Water Hyacinth Manure ; 100% WHM = whole water hyacinth manure (1:0); 50% WHM = 50% water hyacinth manure + 50% garden soil (1:1); FYM'W = 25% water hyacinth manure + 75% farm yard manure (1:3); CNTR = whole garden soil as control (0:1); S/R = Shoot / Root; F.wt. = Fresh weight; D.wt. = Dry weight