Study the Efficiency of Composted Herbal Biomass as a Source of Nutrients for Vegetative Growth and Nutritional Composition of Okra

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Abstract- Present study was aimed to determine the effect of herbal pharmaceutical solid waste compost on the growth, pod yield and nutritional value of okra. Compost was prepared by using herbal pharmaceutical solid waste in combination with cow manure under windrow composting technique. Three different doses i.e. 25, 37.5 and 50 kg Nha^{-1} were applied to okra crop. The experiment was arranged in a randomized complete block design with three replications. Growth, yield, mineral and vitamins of okra were assessed. The results showed that various treatments had significant effects on growth, yield and chemical composition of okra above the control plants in which no compost was applied but among three doses application of 50 kg Nha^{-1} herbal pharmaceutical solid waste compost significantly increased the growth, yield and level of minerals and vitamins.

Index Terms- Composting, herbal biomass, okra, nutritional composition

I. Introduction

The intensive use of inorganic fertilizers is causing adverse effects on the physical, chemical and biological properties of soil. The inadequate and imbalance use of chemical fertilizer is resulting in stagnant even low crop yields in Pakistan as compare to other developed countries. Due to high cost and unavailability of fertilizers at the time of application poor Pakistani farmers are using polluted municipal and industrial wastes as a source of nutrients and organic matter Younas and Shahzad (1998) and Jamal et al. (2002).

Herbal pharmaceutical waste (HPSW) from herbal pharmaceutical industry contains high concentrations of organic matter. It contains several herbs like saunf (*Foeniculum vulgare*), Bad-e-musk, balchar (*Nardostachys Jatamansi*), banafsha (*Viola odorata*, subistan and tea (*Camellia sinensis*). Presently in Pakistan herbal waste material is collected and dumped into the municipal landfills, resulting loss of potentially valuable organic material that can be processed as organic fertilizer Ferhan et al. (2010).

Recycling of organic waste into nutrient rich organic compost by composting method is a cost effective and environment friendly way. Composting is biological decomposition of organic matter under controlled condition Adegunloye (2009) and Popkin (1995). Organic inputs mainly of plant and animal origin are the good source of organic matter and nutrients Sharma et al. (2005). Composted organic waste materials not only sustain the fertility of the soil but also use least resources to produce high quality of nutritious food Batman et al. (1993). Many researchers Stone et al. (2003), Drinkwater et al. (1995), Lewis et al. (1992) and Trankner et al. (1992) have been reported that decomposing plant residues are not only release substantial levels of nutrients and organic matter into the soil but also improve soil functions and suppress soil borne diseases
Okra (*Hibiscus esculentus*) locally called Bhindi is an annual dicotyledonous herb belongs to the family Malvacea. It is a warm season crop grown throughout the tropical and subtropical parts of the world. Okra is a powerhouse of valuable nutrients; it provides most of the dietary fibers, proteins, fats, minerals and vitamins in human diet. It contains approximately 86.1 % moisture, 2.2 % protein 9.7 % carbohydrates, 0.2 % fat and 0.9 % ash Ihekoronye and Ngoddy (1985). Its medicinal importance also makes it a valuable addition to the diet Chiej (1984) and Facciola (1990).

Keeping in view the environmental problems associated with the disposal and also to mitigate the serious deficit of organic matter suffered by many agricultural soils, caused by the low use of organic materials in the fertilization programmes of crops. Present work was therefore, carried out to study the efficiency of composted HPSW as a source of nutrients for vegetative growth and nutritional composition of okra.

II. Materials and Methods:

Source material:

Composting of herbal pharmaceutical solid waste was carried out during the month of September-October. Prepared compost feed having 26 C: N was piled up in the form of windrow on outdoor unpaved ground and exposed to temperatures between 40-45°C for 08 weeks. After completion of composting process composted mass was thereafter left for a week to mature. 2 in1 organic compost (commercial name) and inorganic NPK purchase from the local market.

Field trail experiment:

Experiments were conducted during March 2011 to September 2011 at PCSIR Laboratories complex Karachi. Temperatures average between 35 °C-40°C. The soil was sandy loam in texture.

Treatments comprising of HPSW organic compost applied at 25, 37.5 and 50 kg Nha^{-1} were compared with commercially available compost applied at 50 kg Nha^{-1}, NPK applied at 50 kg

Nha^{-1} and control (without any amendment). All the treatments were replicated three times in a randomized complete block design. Each amendment was applied only one time into the soil one week before sowing. All amendments were uniformly mixed with the surface soil (0-15 cm).Okra seeds were planted at 0.25 m within rows and 0.5 m between rows. Total mean yield from each treatment was determined by harvesting all the okra pods in the three replicate plots. Weeding and sprays against insects and pests were done uniformly in all treatments. At maturity, data regarding plant height, fresh pod yield g $plant^{-1}$, number of pods $plant^{-1}$ and nutritional value of freshly harvested pods were recorded.

Chemical Analysis:

Soil was analyzed for texture, electrical conductivity, pH and organic matter by using standard methods AOAC (2005).

Freshly harvested, matured okra pods were analyzed for moisture, fat, protein and ash content according to standard methods AOAC (2005). Total moisture was determined in an oven at 65 °C till constant dry weight while ash content was determined through combustion in a muffle furnace at 550°C for 6 h, total Kjeldahl nitrogen was determined by Kjeldahl method. Fat content was estimated by petroleum ether extraction. Calorific value of the powdered okra pods was determined on Ballistic Bomb Calorimeter (Gallenkamp).

Determination of minerals:

For the estimation of mineral composition, dried and powdered okra pods were digested with concentrated nitric acid and hydrochloric acid and then determined by using atomic absorption spectrophotometer AAS, Z-8000 Hitachi AOAC(2005)

Determination of Vitamin B complex:

Vitamins were extracted from okra pods by using 0.1 N HCl. After extraction samples were digested in a boiling water bath for 30 min. followed by pH adjustment up to 4.0-4.5 using 2.5 M sodium acetate buffer, 10% enzyme solution (Takka diastase) was then added and incubated for 3 h at 45°C -50°C. The preparations were cooled, filtered and diluted with distilled water. Finally prepared aliquots were analyzed by HPLC (Agilent 1100) equipped with Zorbax SB-C8, 4.6 x150mm, 5nm column.

III. Results and Discussion:

Okra plant height was significantly affected by all applied amendments. Mean values for plant height under composted HPSW @ 25, 37.5, 50 kg N ha^{-1}, NPK @ 50 kg N ha^{-1}, 2 in one compost @ 50 kg ha^{-1} and control were 82.37, 91.89, 143.66, 146.29, 92.93, 122.74 and 82.37 cm, respectively. Data revealed that okra plant height significantly increased by all treatments with respect to control although, plants treated with 2 in one compost and NPK at 50 $kgNha^{-1}$ also showed better output but it is evident that the plants from plots treated with composted HPSW at 37.5 and 50 kgN ha^{-1} showed maximum plant heights which are 77.24 % and 74.40 % greater as compare to control. Oshunsanya, 2010 suggested that increase or decrease in plant height depends upon soil water holding capacity, soil aggregation and bulk density so; the prominent increase in the plant heights reflects the ameliorative effect of the composted HPSW on the properties of the soil. If we compare mean plant heights obtained by the application of three different dose of composted HPSW it can be seen that increase in dose quantity also bring about increase in plant height. This account for highest plant height on plots that treated with 50 $kgNha^{-1}$ composted HPSW might be due to increased reduction in bulk density of soil and ability to mineralize gradually.

Similarly, higher fresh pod yields were recorded again in the plots that received composted HPSW @ 37.5 and 50 $kgNha^{-1}$which are respectively 22 and 25 % higher with compared to control. Similarly composted HPSW @ 25$kgNha^{-1}$, NPK @50$kgNha^{-1}$ and 2 in one compost give 13, 15 and 19 % increased yield with respect to control. The same trend was observed in case of number of pods $plant^{-1}$ as maximum number of pods i.e. 21 and 18 was observed in plots that received composted HPSW @ 37.5 and 50 $kgNha^{-1}$. It was also noticed that yields increase with increasing rates of composted HPSW.

Results of proximate analysis of okra pods harvested from different treatments including control are mentioned in table 2. In case of moisture content of okra pods harvested from all treatments including control a non- significant difference was observed and values were found in the range 87.69 %-90.31% which is within the standard range Ihekoronye and Ngoddy (1985). Results of % fat, % protein, % mineral content and energy value also showed no marked differences within the treatments and control.

Results achieved for vitamin B complex concentration determined in okra pods harvested from all treatments showed increase in the level of B complex content with respect to control. Higher concentrations of B complex series were found in pods harvested from plots treated with 50 kg Nha^{-1}, i.e. concentration of folic acid 65 µg / 100g, pyridoxine 0.23 mg / 100g, niacin 2.1 mg / 100g, riboflavin 0.13 mg / 100g and thiamine 0.19 mg / 100g. If we compare obtained values for B complex in okra pods harvested from all applied treatments with the standard values recommended by USDA we found out that excluding values obtained by pods harvested from plots treated with 50 kg Nha^{-1}, all other treatments showed values lower than the standard values.

Mineral analysis of the okra pods harvested from different treatments showed highest concentration level of Ca, Na and Zn was revealed in pods harvested from plots that received 50 kg Nha^{-1}, while the concentration of Mg and Fe was highest in pods harvested from plots treated with 37.5 kg Nha^{-1}. The remaining minerals like Mn and Cu showed no significant variation among all treatments including control.

IV. Conclusion:

On the basis of achieved Findings it can be concluded that the use of composted HPSW as a source of plant nutrient may be a suitable option and have potential to reduce dependence on chemical fertilizers. In addition, okra pods harvested from the composted HPSW treated okra plants have fairly good content of nutrients and were envisaged as a good source of minerals, proteins, fats and energy value.

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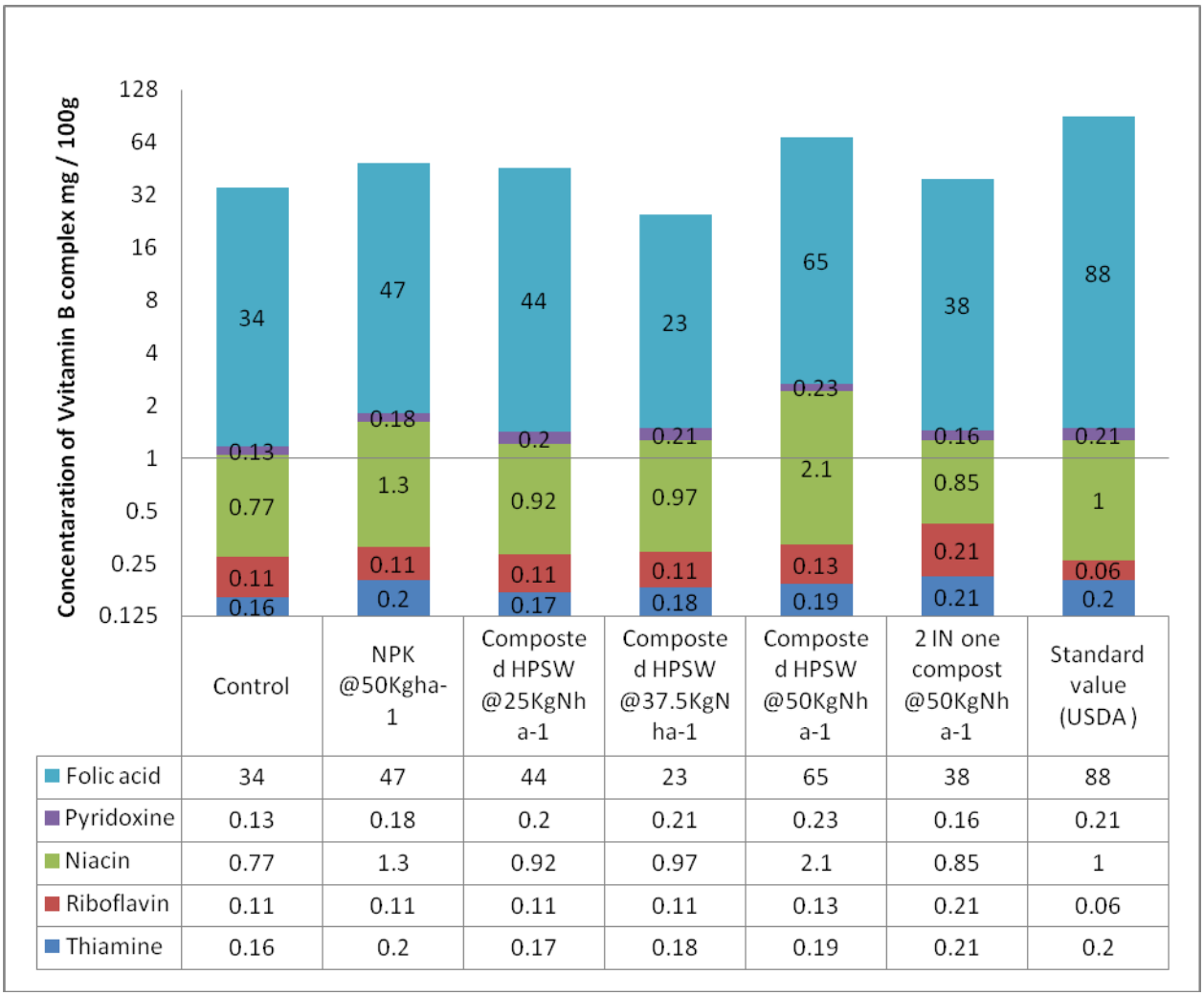
Table-1: Effect of different treatments on the growth and yield of okra.

Treatments	Parameters		
	Plant Height (cm)	Pod Yield (g plant^{-1})	No. of pods plant^{-1}
Control	82.37±16.52	104.7 ±36.10	11.9±4.72
HPSW Compost	91.89±29.88	139.98 ±43.55	16.6±4.55
HPSW Compost (37.5 Kg Nha^{-1})	143.66±46.99	231.39±101.52	18.06±4.35
HPSW Compost (50 Kg Nha^{-1})	146.29±12.60	267.1±10.15	21.00±3.55
2 in one Compost (50 Kg Nha^{-1})	122.74±61.47	208.46±176.16	14.83±4.16
NPK	92.93±42.46	156.60±32.76	14.60±5.23

($50Kg\ Nha^{-1}$)

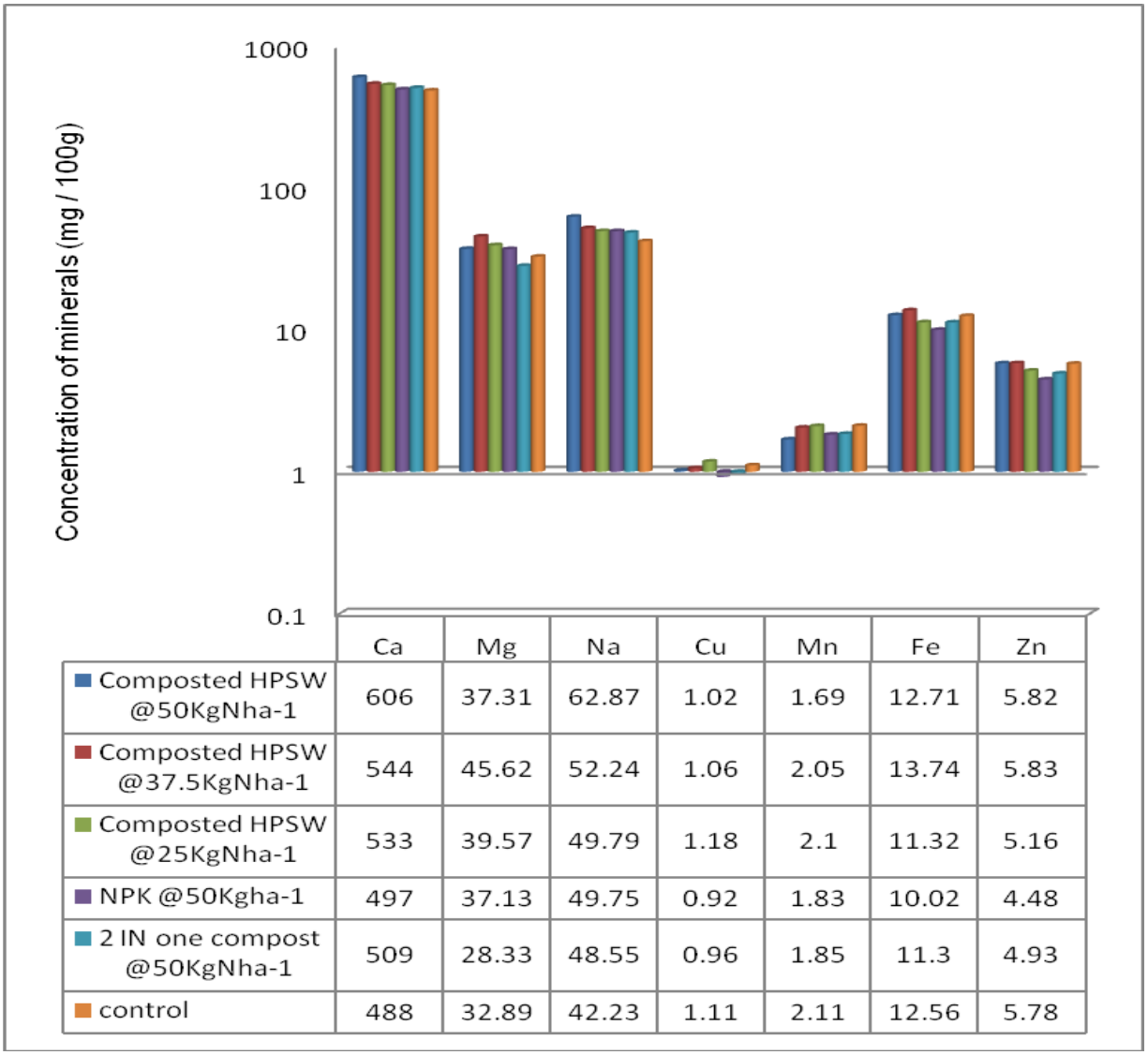
Table-2: Effect of different treatments on proximate analysis of okra pods.

Parameters	Treatments					
	Control	HPSW Compost (25 Kg Nha^{-1})	HPSW Compost (37.5 Kg Nha^{-1})	HPSW Compost (50 Kg Nha^{-1})	2 in one Compost (50 Kg Nha^{-1})	NPK (50Kg Nha^{-1})
Moisture %	88.20±1.5	88.40±3.50	88.81±1.25	88.85±3.1	89.52±4.23	90.31±1.19
Fat %	2.11±0.50	2.27±1.06	2.31±0.50	2.35±0.12	2.38±1.16	2.68±0.25
Protein %	14.52±3.25	15.58±3.55	16.20±1.25	17.96±3.6	14.33±1.97	16.29±2.21
Calorific Value Kcal / 100g	1825	1879	1923	1980	1825	1850
Mineral Content %	9.23±1.47	9.41±0.95	9.56±1.25	9.99±1.22	9.63±1.52	10.36±0.95



	Control	NPK @50Kgha-1	Composted HPSW @25KgNha-1	Composted HPSW @37.5KgNha-1	Composted HPSW @50KgNha-1	2 IN one compost @50KgNha-1	Standard value (USDA)
Folic acid	34	47	44	23	65	38	88
Pyridoxine	0.13	0.18	0.2	0.21	0.23	0.16	0.21
Niacin	0.77	1.3	0.92	0.97	2.1	0.85	1
Riboflavin	0.11	0.11	0.11	0.11	0.13	0.21	0.06
Thiamine	0.16	0.2	0.17	0.18	0.19	0.21	0.2

Fig-1: Comparative effect of different treatments on vitamin B complex content of okra pods.



	Ca	Mg	Na	Cu	Mn	Fe	Zn
Composted HPSW @50KgNha-1	606	37.31	62.87	1.02	1.69	12.71	5.82
Composted HPSW @37.5KgNha-1	544	45.62	52.24	1.06	2.05	13.74	5.83
Composted HPSW @25KgNha-1	533	39.57	49.79	1.18	2.1	11.32	5.16
NPK @50Kgha-1	497	37.13	49.75	0.92	1.83	10.02	4.48
2 IN one compost @50KgNha-1	509	28.33	48.55	0.96	1.85	11.3	4.93
control	488	32.89	42.23	1.11	2.11	12.56	5.78

Fig-2: Comparative effect of different treatments on mineral content of okra pods.