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Residual Effect of Segregated and Unsegregated Urban Solid Waste Compost on Quality of Cowpea (*Vigna unguiculata* L.)

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Authors' contributions

This work was carried out in collaboration between all authors. Author Roohi designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors HCP and HMM managed the analyses of the study. Author HMM managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

A greenhouse experiment was conducted to study the residual effect of segregated and unsegregated urban solid waste compost on chlorophyll content, crude fiber and crude protein in cowpea (*Vigna unguiculata* L.) during *kharif*-2016 in Department of Soil Science and Agricultural Chemistry, University of Agricultural Sciences, Gandhi Krishi Vignana Kendra, Bangalore (India). The results revealed that chlorophyll content, crude fiber and crude protein content were significantly improved by the application of 100% NPK + segregated urban solid waste compost (10 t ha^{-1}) followed by 100% NPK + unsegregated urban solid waste compost (10 t ha^{-1}) as compared to the treatment which includes only inorganics.

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Keywords: Residual; segregated; unsegregated urban solid waste compost; chlorophyll content; crude fiber; crude protein and cowpea.

1. INTRODUCTION

Among the pulses, cowpea (*Vigna unguiculate* L.) is one of important crop grown in arid and semiarid tropics of India and it is used as a grain, green pods and fodder. Cowpea is grown as a catch crop, mulch crop, intercrop, mixed crop and green manure crop. It has the ability to fix atmospheric nitrogen in soil at the rate of 56 kg ha^{-1} in association with symbiotic bacteria under favourable conditions [1]. Cowpea and other legumes are recognized as important sources of protein. The grains and leaves are the source of carbohydrates, proteins, fats, ß-carotene, and vitamins B and C, which are necessary for maintaining good health [2]. In Karnataka, the crop is grown in an area of 1.5 million hectares with a production of 0.49 million tonnes. The productivity of cowpea in Karnataka is low (420 kg ha^{-1}) as compared to the national productivity of 567 kg ha^{-1}.

Urban solid waste can be defined as any solid or semi-solid substance or object resulting from human or animal activities, discarded as useless or unwanted materials. It is an extremely mixed mass of wastes, which may originate from household, commercial, industrial or agricultural activities. Municipal solid waste (MSW) composting, however, has proved to be a safe and effective way to accelerate the decomposition and stabilization of biodegradable components of bio-waste from MSW, leading to production of compost for soil amendment or as an organic nutrient source [3,4]. Composting is gaining interest as a suitable alternative for chemical fertilisers with environmental profit, since this process eliminates or reduces toxicity of MSW [5,6] and leads to a final product which can be used in improving and maintaining soil quality. Many studies have shown that the compost improves physical and chemical properties of soils by increasing nutrient content, organic matter, water holding capacity and cation exchange capacity. Thus, contributing to an improvement of crop yield and quality [7]. Urban solid waste compost consists about 51 percent of organic waste, utilizing it in agriculture not only improves soil fertility but also can save chemical fertilisers, if it is utilised scientifically through segregation and composting which results in mitigating environment pollution. Keeping these points in view, the present investigation was studied aiming to partially replace chemical fertiliser with segregated and unsegregated urban solid waste compost and study its effect on chlorophyll content, crude fibers and crude protein in cowpea (*Vigna unguiculata* L.).

2. MATERIALS AND METHODS

A pot experiment was conducted to study the residual effect of segregated and unsegregated urban solid waste compost on chlorophyll content, crude fibers and crude protein in cowpea (*Vigna unguiculata* L.) variety IT-38956-1. The experiment was conducted in Department of Soil Science and Agricultural Chemistry, University of Agricultural Sciences, Gandhi Krishi Vignana Kendra, Bangalore (India) during *kharif*-2016. In the previous year (*kharif* -2015) the finger millet crop was taken as a main crop in the same pot (8 kg soil pot^{-1}) study where the soil was treated with segregated, unsegregated compost and Farm Yard Manure (FYM) with 100, 50 and 50 kg N, P_2O_5 and K_2O ha^{-1}, respectively (50 and 100 percent). The initial soil properties of experimental was found that soil was acidic in nature pH (5.96) determined by the method outlined by Jackson [8], EC of 0.11 (dS m^{-1}) was determined using clear extract of soil: water suspension using conductivity bridge [8], low in organic carbon (0.36 percent) was determined by method given Walkley and Blackby [9], Available nitrogen was low (194.12 kg ha^{-1}) determined by the method outlined by Subbiah and Asija [10], available P_2O_5 was medium (35.36 kg ha^{-1}) and available K_2O was low (87.6 kg ha^{-1}) determined by the method outlined by Merwin and Peech [11]. The soil used in this experiment was treated with segregated and unsegregated compost that were prepared with the use of urban solid waste containing organic waste such as vegetables, fruits, flower, dry leaves etc. were separated and transferred into drum composter. Drum composter is a method of preparation of compost using biodegradable organic waste in an air circulated horizontal rotatory drum container. Using drum composter, the compost is prepared within 75 - 80 days and it is called segregated urban solid waste compost which is having less concentration of heavy metals. The unsegregated urban solid wastes containing both organic and solid waste are transferred into the drum composter without separation. The compost was prepared aerobically as followed in the segregated urban solid waste compost preparation. The chemical composition of segregated, unsegregated urban solid waste

compost and Farm Yard Manure (FYM) is presented in Table 1.

The experiment was laid out in a Complete Randomized Design (CRD) with three replications. The residual treatments were T_1 - 100% NPK + FYM at 10 t ha^{-1} (Package of Practice); T_2 - Segregated compost (10 t ha^{-1}); T_3 - Unsegregated compost (10 t ha^{-1}); T_4 - FYM (10 t ha^{-1}); T_5 - 100% NPK + Segregated compost; T_6 - 100% NPK + Unsegregated compost; T_7 - T_2 + 50% NPK; T_8- T_3 + 50% NPK; T_9 - T_4 + 50% NPK; T_{10} - 50% NPK; T_{11} - 100% NPK. Crude protein and crude fibers content in haulm and grain of cowpea at 90 d after sowing were determined by method proposed by AOAC [12]. Chlorophyll readings were taken with a hand-held dual wavelength meter (SPAD 502) at 30 d after sowing.

2.1 Statistical Analysis

The data obtained from the study were subjected to statistical analysis of variance method at 5% level of significance as per the procedure given by Sundaraj et al. [13].

3. RESULTS AND DISCUSSION

Residual effect of segregated and unsegregated urban solid waste compost on crude protein and crude fiber in cowpea grain and haulm is presented in Fig. 1.

The results indicated that crude protein content in cowpea haulm (8.92%) and grain (25.33%) was significantly higher in the residual treatment (T_5) comprised of 100% NPK + segregated urban solid waste compost at 10 t ha^{-1} followed by treatment (T_6) comprised of 100% NPK + unsegregated urban solid waste compost at 10 t ha^{-1} which recorded 8.83% in haulm and 24.79% in grain as compared to treatment (T_{10}) comprised of 50% NPK which recorded 8.06% in haulm and 20.71% in grain. This might be due to large proportion of nitrogen was available to cowpea crop through segregated and unsegregated composts upon mineralization [14]. Increase in the crude protein content of cowpea can be attributed to the higher nitrogen content in the legume crops and also large proportion of available nitrogen from compost to cowpea [15]. The

Table 1. Physical and chemical composition of segregated, unsegregated urban solid waste compost and Farm Yard Manure (FYM) used in the pot culture experiment

Parameters	FYM	Segregated compost	Unsegregated compost
Physical properties			
Moisture (%)	20.12	23.65	22.03
Colour	Brown	Black	Black
Bulk density (g cm^{-3})	0.98	1.01	1.04
Chemical properties			
pH (1:10)	7.2	7.35	7.84
EC (dS m^{-1})	1.22	1.12	1.51
Organic carbon (%)	17.77	29.16	24.17
C: N ratio	29.01	17.78	19.18
N (%)	0.61	1.64	1.22
P (%)	0.18	0.45	0.32
K (%)	0.52	1.11	0.91
Ca (%)	0.68	1.47	0.95
Mg (%)	0.27	0.74	0.56
S (%)	0.21	0.76	0.64
Zn (mg kg^{-1})	13.86	118.07	143.17
Cu (mg kg^{-1})	2.2	42.11	44.23
Fe (mg kg^{-1})	520.3	3529.11	3604
Mn (mg kg^{-1})	38.12	350.67	366.33
Ni (mg kg^{-1})	18.21	12.75	23.42
Cd (mg kg^{-1})	ND	ND	ND
Pd (mg kg^{-1})	ND	23.87	43.62
Cr (mg kg^{-1})	ND	12.53	21.34

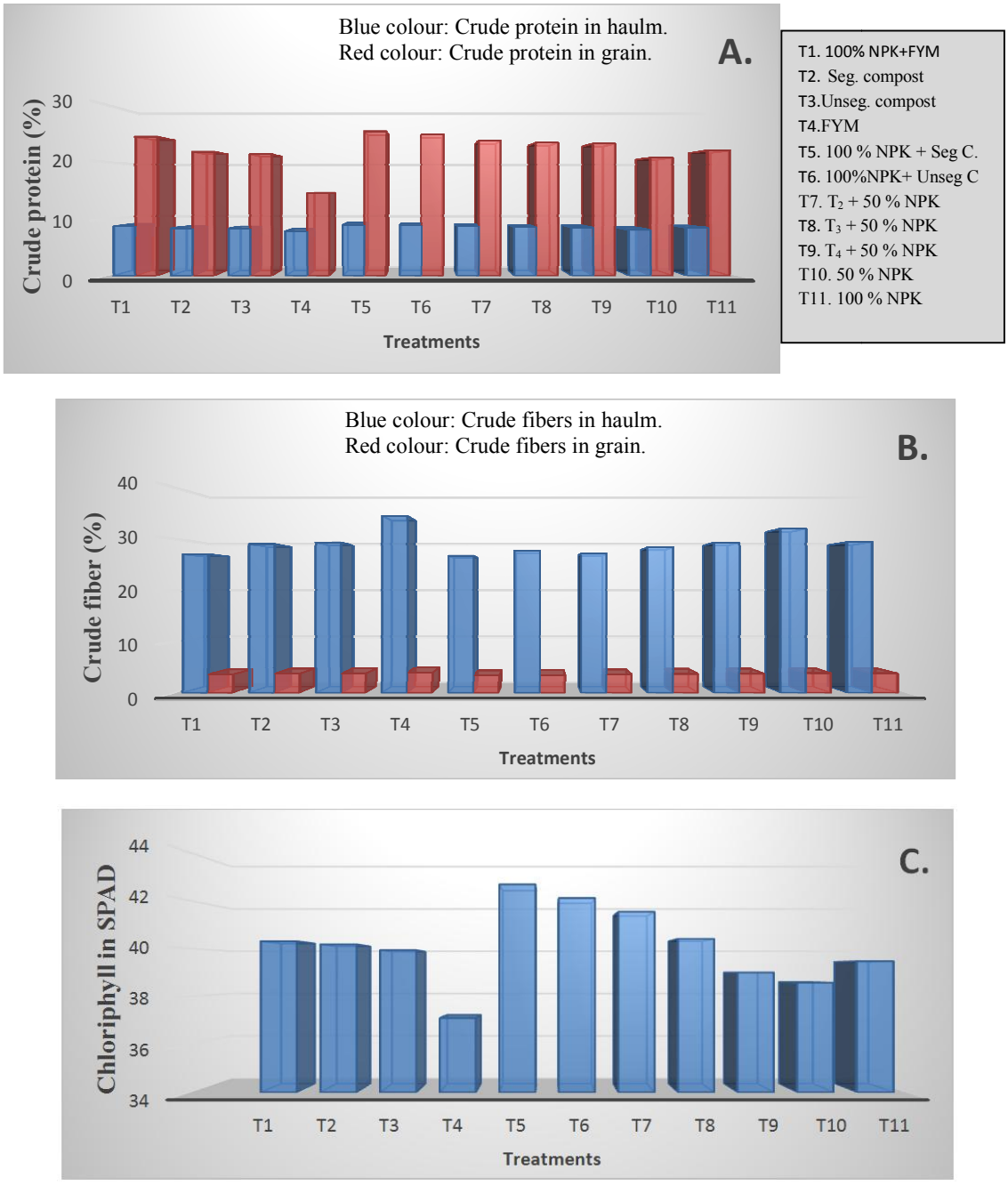

Fig. 1. Residual effect of segregated and unsegregated urban solid waste composts on A. Crude protein in cowpea haulm and grain B. Crude fiber in cowpea haulm and grain and C. Chlorophyll content of cowpea leaves

FYM= Farm Yard Manur at 10 t ha^{-1}, Seg.= Segregated, Unseg= Unsegregated, C= Compost

increased crude protein yield of cowpea forage was also reported by Sultana et al. [16]. The results are in consonance with the findings of Rostami et al. [17]. Mohammadreza et al. [18] also reported an increase nitrogen content and uptake in soya bean with the application of municipal solid waste compost.

The higher crude fibers content of cowpea haulm (34.43%) and grain (4.00%) was recorded where

FYM alone was applied. High crude fiber percentage could be attributed to less availability of nitrogen and the low crude fiber of cowpea haulm (26.67%) and grain (3.43%) was found in the treatment where high nitrogen was available in the treatment (T_5) comprised of 100% NPK + segregated compost. Nitrogen application increased the protein synthesis and decreased pectin, cellulose and hemicellulose contents, which are major constituents of crude fiber [19]. Gasim [20] stated that increased in nitrogen level reduced fiber content of maize forage. A similar result was reported by Adam [21].

The higher chlorophyll content (42.67) was recorded where 100% NPK + segregated compost was applied which might be since nitrogen is an important constituent of chlorophyll and higher amount of nitrogen was being supplied by treatment comprising of 100% NPK + segregated compost compared to inorganics alone. Prasanna [22] while working on cotton, also found that improved nitrogen application enhanced the chlorophyll content.

4. CONCLUSION

The application of segregated urban solid waste compost to finger millet crop during *kharif*-2015 and its residual effect on cowpea which was planted next season after finger millet significantly improved the quality of cowpea i.e., crude protein, crude fiber and chlorophyll content as compared to inorganics fertilizers alone.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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