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Utilization of composted agricultural waste as organic fertilizer for the growth promotion of sunflower plants

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Abstract
The present study examined the effects of composted Wheat Bran (5 g/2 kg of soil/pot) on physical and biochemical parameters of sunflower plants after 30 days of germination. Results showed significant progress in physical and biochemical parameters of plants as compared to control plants. Wheat Bran composted with *T. hamatum* (JUF1) in combination with *Rhizobium sp-I* (JUR1) and *Rhizobium sp-II (JUR2)* were found more effective in improving the shoot and root lengths while Wheat Bran composted with *Rhizobium sp-I* (JUR1) promote significantly carbohydrate, crude protein and mineral content of sunflower plants. It shows that composted Wheat bran may boost the soil fertility by refining its organic content.

Keywords: Compost, Wheat Bran, Microbial inoculants, Sunflower.

1. Introduction
Plants require a number of soil nutrients like nitrogen (N), phosphorus (P) and sulfur (S) for their growth. But, soil nutrient levels can decrease over time when crop plants are harvested, as nutrients are not returned to the soil [1]. Therefore, these vital nutrients need to be reimbursed either through the natural way of decomposition or by the easy means of adding fertilizers. Subsequently salt content is one of the most dangerous characteristics of chemical fertilizers; they are likely to be deleterious to agriculture in the long run as salts are injurious to plants as well as soil. Constant use of these chemical fertilizers reduces essential soil nutrients and minerals that are naturally found in fertile soil [2].

Organic fertilizers are not like them; they are slow discharge which will permit time for microbial action to breakdown the organic materials in the fertilizers. Once we talk of microbial action; we want to evoke that natural microorganisms; which contain helpful insects, fungus, and bacteria found in the soil, are very much helpful for vigorous soil and plant development [3]. Use of chemical fertilizers will kill these soil friendly microorganisms.

Organic agriculture is a system of farming those beliefs on procedures for example, green manure, crop rotation, compost, and biological pest control. Composts made by assimilation of organic wastes in suitable levels into piles, rows, or vessels; adding bulking agents as essential to accelerate the breakdown of organic materials [4].

Sunflower (*Helianthus annuus* L.) is one of the few crop species that originated in North America. Sunflower accounts for about 14% of the world production of seed oils. Sunflower oil is used normally in the production of cleansers, detergents, as a pesticide carrier, and in the making of agrichemicals, surfactants, glues, plastics, fabric softeners, lubricants [5]. The present study was designed to investigate the comparative effect of different microbes to convert the agricultural waste into compost as organic fertilizer to promote the growth and development of sunflower plants.

2. Materials and methods
Microorganisms containing *T. hamatum* (JUF1) and *Rhizobium* species, i.e., Rhizobium sp. I (JUR1) and *Bradyrhizobium* sp. II (JUR2) were isolated by root plating and crushed nodule method [6].

Wheat Bran inoculated with each of the test microorganism (10^{11}–10^{12} cfu/mL) alone and in different combinations (Table 1) under sterilized condition for 15 days at room temperature.

The concentration of each experimental microorganism was adjusted with the help of SMIC haemocytometer ART. No.1280 [7].

After the incubation period, composted Wheat Bran was oven dried at 80 ^{0}C for 2 hours and grinded to use as composted organic fertilizer in pot experiment.

Seed of sunflower plants were purchased from Old vegetable market, Hyderabad, Pakistan and Wheat Bran purchased from local market, Saddar, Karachi, Pakistan.

Table 1: Treatments of test microorganism alone and in combination used to prepare composted organic fertilizer.

S. no.	Treatments	Code
1	Control	Control
2	*Rhizobium sp*-I (1011–1012 cfu per mL)	JUR1
3	*Bradyrhizobium sp*-II (1011–1012 cfu per mL)	JUR2
4	*Trichoderma hamatum* (1011–1012 cfu per mL)	JUF1
5	*Rhizobium sp*-I (1011–1012 cfu per mL) + *T. hamatum* (1011–1012 cfu per mL)	JUR1 + JUF1
6	*Bradyrhizobium sp*-II (1011–1012 cfu per mL) + *T. hamatum* (1011–1012 cfu per mL)	JUR2 + JUF1

The randomized complete block designed pot experiment was conducted in net house of Department of Botany, Jinnah University for Women. At the 7th day of germination of developing seedlings, composted Wheat Bran in an amount of 5g/pot was applied. The plants were collected after 30 days of their germination. Finally the pulls up experimental plants were subjected to physical and biochemical analysis. Five pots were used as replicates for each treatment beside with five controls (untreated) plants. Physical parameters included root & shoot lengths and total carbohydrate by [8], crude protein content by multiplying percent nitrogen value through 6.25 [9] and mineral content (N,P) by Nessler's method [10] as biochemical parameters.

Statistical Analysis. Results are expressed as mean ± standard deviation (S.D.) and data was analyzed by using *One way* ANOVA followed by LSD (least significant difference) test through SPSS 16. The differences were considered significant at $P < 0.05$ when treatments' means were compared with control.

3. Results & discussion

Soil organic matter can be improved by adding uncomposted and composted organic wastes or biodegradable products. . A lot of research has been done to describe the benefits of organic amendments in improving the three important aspects of soil, including physical, chemical and biological but depend on quantity and composition [11].

In the present study, composted organic fertilizer (COF) application provoked a significant improvement in physical and biochemical parameters of experimental plants as compared to control plants treated with uncomposted organic fertilizer (UCOF) and it was clearly indicated that addition of COF may increase the organic content of soil. Application of organic wastes from different sources is one of the traditional methods to improve the crop yield [12].

Table 2: Effect of composted wheat bran on root & shoot lengths of *H. annuus* (sunflower) plants

Wheat bran (5 gm)		30th day	
S. No.	Treatment	Root length (cm)	Shoot length (cm)
1	Control	20.16 ± 0.41	30.0 ± 0.43
2	JUR1	21.2 ± 1.12 (5.15)	35.0 ± 3.29^{d} (16.66)
3	JUR2	22.3 ± 0.75 (10.61)	45.6 ± 3.25^{a} (52)
4	JUF1	20.93 ± 0.63 (3.81)	42.1 ± 3.40^{a} (40.33)
5	JUR1+JUF1	24.3 ± 3.7^{d} (20.53)	45.85 ± 2.87^{a} (52.83)
6	JUR2+JUF1	24.63 ± 2.4^{d} (22.17)	46.66 ± 2.63^{a} (55.53)

Each value is the mean ± S.D (standard deviation) of 5 replicates. Means bearing superscripts in each column are significantly different with respective control at $p < 0.05$(LSD). Values within parenthesis represent percent increase or decrease (-) with respective control.

Wheat bran composted by JUR1 and JUF1 @ 5 g found active in stimulating the root length of sunflower plants after 30 days of uprooting. WB composted by JUR2+JUF1 @ 5 g only found dynamic and produced 22% increase in root length of experimental plant after 30 days (Table 2).Wheat bran composted by all selected treatments @ 5 and produced significant effects on shoots of test plants by promoting their length after 30 days of germination. Maximum 55% elongation was also observed in shoots of test plants on the 30th day by JUR2+JUF1 composted WB (Table 2). Also proved by another study in which application of composted wheat bran had the positive effect on the shoot length upto 27% over control [13].

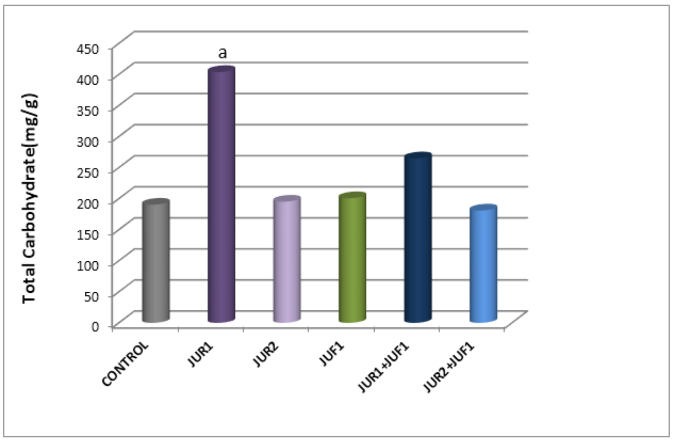

Fig 1: Effect of composted wheat bran @ 5 gm on total carbohydrate of *H. annuus* Plants after 30 days. Column bearing superscripts are statistically significant ($p < 0.05$ LSD) with respective control.

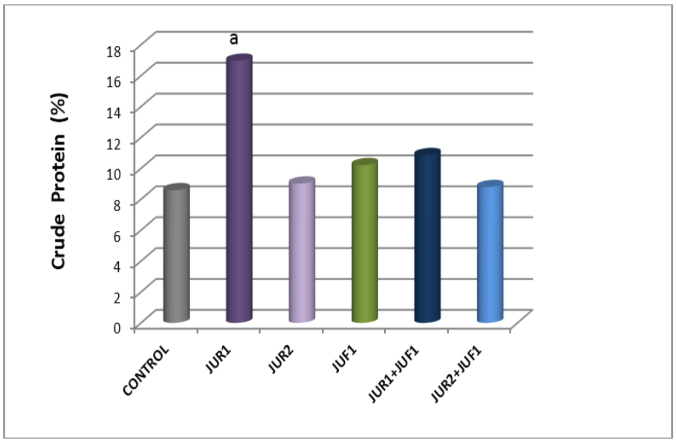

Fig 2: Effect of composted wheat bran @ 5 gm on crude protein (%) of *H. annuus* plants. Column bearing superscripts are statistically significant ($p < 0.05$ LSD) with respective control.

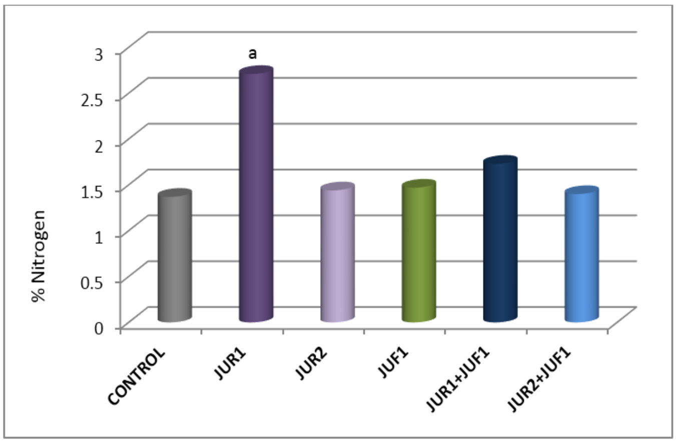

Fig 3: Effect of composted wheat bran @ 5 gm on Nitrogen (%) of *H. annuus* plants. Column bearing superscripts are statistically significant ($p < 0.05$ LSD) with respective control.

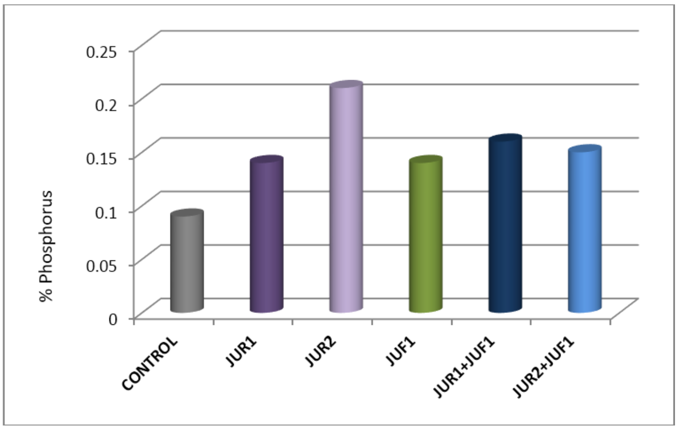

Fig 4: Effect of composted wheat bran @ 5 gm on Phosphorus (%) of *H. annuus* plants. Column bearing superscripts are statistically significant ($p < 0.05$ LSD) with respective control.

All treatment @ 5 g found efficient and increased in carbohydrate content in sunflower plants on 30th day except with the treatment of JURI+JUF1.Wb composted with JUR1 significantly improved the carbohydrate content in sunflower plants at 30th day of germination (Figure 1). All treatments of composted WB @ 5g found to increase the crude protein content in test plants on 30th day of uprooting of plants (Figure 2).Only with JUR1composted WB significantly improved the crude protein content. WB composted with JUR1 @ 5 g improved the nitrogen content of sunflower plants from 98% at 30th day. Though, WB composted with JUR1+JUF1 @ 5g was observed to rise nitrogen content with 26% on 30th day (Figure 3).

Wheat bran (WB) composted with all treatments, especially JUF1 found effective in improving the phosphorus content of sunflower plants increased up to 133% with WB composted with JUR2 @ 5 g on 30th day. While all remaining treatments of composted WB increased the phosphorus content from 55-80% on 30th day (Figure 4).

Wheat bran (WB) composted with all treatments, especially JUF1 found effective in improving the growth and nutritional status of sunflower plants. The test microorganisms used in the present study for composting of organic food wastes were *T. hamatum*, *rhizobium* and *bradyrhizobium* species, are well-famous producers of lytic enzymes, including β-1,3-glucanase, chitinase, cellulose, etc, [14] found efficient in producing biodegradable product and improving organic matter of soil on its application.

Study showed that the quality of the compost vary which actually depends on composting feed material that make difficult to predict its applicable rates and investigate its beneficial effects on soil nutrient content, soil conditioning and bio-control properties [15]. Organic amendment of soil by means of rice husk was found active in the harvest of several crops like cowpea and rice [16, 17].

It was similarly detected that composting of agronomic wastes with the support of nominated bacteriological treatments enhanced its total carbohydrate and crude protein contents which might work as good sources of carbon and nitrogen. Respectively, may facilitate to restore or increase the fertility of degraded soil [18]. The technically made 'organic fertilizers' with current information in biotechnologies are much more nutritive and useful than those produced traditionally by farmers in earlier days [19].

4. References

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