International Journal of Biological, Life and Agricultural Sciences
ISSN: 2415-6612
Vol:13, No:11, 2019

The Effects of Cow Manure Treated by Fruit Beetle Larvae, Waxworms and Tiger Worms on Plant Growth in Relation to Its Use as Potting Compost

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Abstract**—**Dairy industry is flourishing in world to provide milk and milk products to local population. Besides milk products, dairy industries also generate a substantial amount of cow manure that significantly affects the environment. Moreover, heat produced during the decomposition of the cow manure adversely affects the crop germination. Different companies are producing vermicompost using different species of worms/larvae to overcome the harmful effects using fresh manure. Tiger worm treatment enhanced plant growth, especially in the compost-manure ratio (75% compost, 25% cow manure), followed by a ratio of 50% compost, 50% cow manure. Results also indicated that plant growth in Waxworm treated manure was weak as compared to plant growth in compost treated with Fruit Beetle (FB), Waxworms (WW), and Control (C) especially in the compost (25% compost, 75% cow manure) and 100% cow manure where there was no growth at all. Freshplant weight, fresh leaf weight and fresh root weight were significantly higher in the compost treated with Tiger worms in (75% compost, 25% cow manure); no evidence was seen for any significant differences in the dry root weight measurement between FB, Tiger worms (TW), WW, Control (C) in all composts. TW produced the best product, especially at the compost ratio of 75% compost, 25% cow manure followed by 50% compost, 50% cow manure.

Keywords**—**Fruit beetle, tiger worms, waxworms, control.

I. Introduction

In addition to being used in large scale agriculture [4], cow manure has the potential to be used as potting compost, either directly or more probably as an additive to peat and soil based potting composts. Animal wastes, like cow manure can also be profitably used as fertilizers by allotment owners.

Bovine manure contains abundant micronutrients including nitrogen, phosphorous and potassium, making it an ideal plant growing media when added with a mineral rich compound. Potted plants need sufficient space, suitable environmental conditions including temperature and light, besides appropriate supply of water and fertilizers for their optimal growth. Composted manure should always be used as opposed to fresh manure, as fresh manure will burn the root system.

The safest manure for potting compost use comes from herbivores, while manures from carnivores such as dogs and cats possess an added risk of containing human pathogens. Even herbivore manures, however, are extremely strong and need to be aged before being used as potting composts or compost additives [2]. Cow manure contains three main elements of garden soil fertiliser (i.e. N.P, K) but it may contain pathogens like *Salmonella* [2]. By allowing the manure to age, the risk of planting weeds or transmitting diseases through garden crops or contact with the soil is greatly reduced. Manure contains abundant amounts of nitrogen, which help improve the soil and boost plant foliage production. Nitrogen stimulates beneficial bacteria in the soil and speeds up the decomposition of organic materials [2]. But fresh un-aged manure can cause rapid immobilization of nutrients. Tender young plants are also susceptible to too much nitrogen in the soil and can be damaged by it, while plants that absorb too much nitrogen are attractive to insect and other pests [2].

When used in allotments, cow manure is best spread as fresh manure in the autumn after plants are harvested; it is then worked into the soil the following spring before planting. Another approach is to compost the manure in a pile which produced sufficient heat to kill any pathogens or viable undigested weed seeds. Aged cow manure can be used to enrich established garden plots by lightly digging the fertiliser in to the side of plants. Irrigation or rainfall will cause the nutrients to seep into the soil around the plant, feeding the roots [2].

The aim of the work reported in this paper was to determine if cow faeces, when modified by the insect larvae, used here, can provide an improved potting compost, especially when added to peat-based composts, for use in house plant culture.

II. Materials and Methods

A. Seeds, Worms, Larvae and Cow Faeces-Collection and Incubation

Seeds (pea shoots) and containers used in the experiments were bought from local shop. Larvae and worms were purchased online from Ricks Livefood and Original Organics Ltd. Fresh cow faeces were collected from cattle farm, and distributed in 12 plastic boxes (30×20×15 cm) with a lid perforated to allow for gas exchange; 3 boxes of controls (100 g in each box) and 9 boxes of treatment were also set up; WW larvae were then added, 100 larvae to 100 g of cow faeces in each box (3 replicates). FB larvae were then added, ten larvae to 100 g cow faeces were added to each box (3 replicates). TW were then added 40 worms to 100 g cow faeces in each box (3 replicates) [5]. All samples were incubated at 25 ^{o}C throughout the 28 day incubation period.

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B. Compost Transfer to the Cell Insert Trays and Seed sowing

A peat based compost was used. After completion of the incubation period, the manure was moved to cell insert trays (each cell size was L6 cm, D6 cm, W6 cm) with different concentrations from 100% compost (temperate grassland soil), 75% TGS mixed with 25% cow faeces, 50% TGS mixed with 50% cow faeces, 25% TGS mixed with 75% cow faeces and finally 100% cow faeces. Each treatment (FBL, WW, TW and control) was set up in triplicate (Fig. 1). Seeds were then placed in the composts (10 seeds to each). The treated samples were then left at laboratory temperature (circa 23 ^{o}C) and the trays were left near a window to allow for adequate light for plant growth for a period of three weeks (Fig. 2). At the end of the three weeks, the plants were harvested and the following characteristics were determined: plant height, total plant wet weight, fresh leaf weight, fresh root weight, total plant dry weight and root dry weight; the measurements used to assess plant growth were then made.

C. Statistical Analyses

All observations are presented as means ± SE (Standard Error). Bacterial populations were converted to log CFU/g before statistical analysis. Statistical analyses were performed on experimental datasets using the t-test between two groups and a one way ANOVA at $P < 0.050$ probability level compared significance means for four kinds of compost. Results were analysed using Sigma Plot 12.0$^{©}$ software.

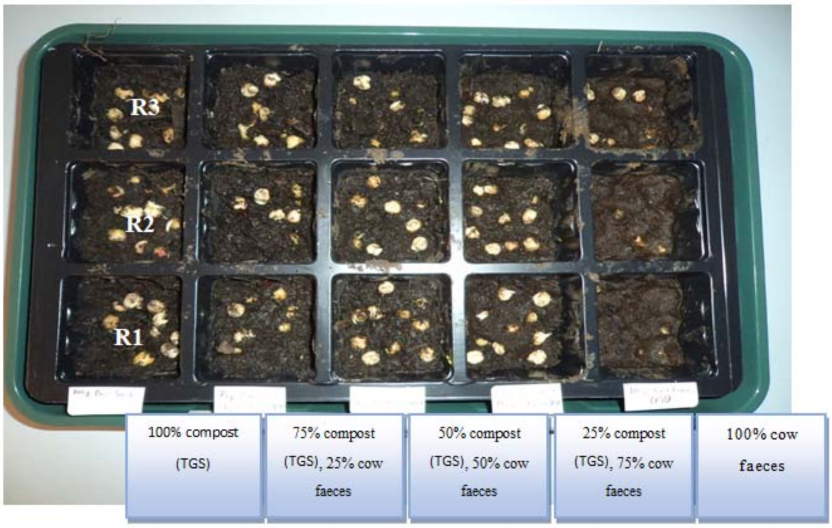

Fig. 1 The compost ratios and replication in cell insert trays

Fig. 2 The effect of cow faeces treated by A) FB, B) WW, C) Control, D) TW, on pea shoots growth in different compost ratios

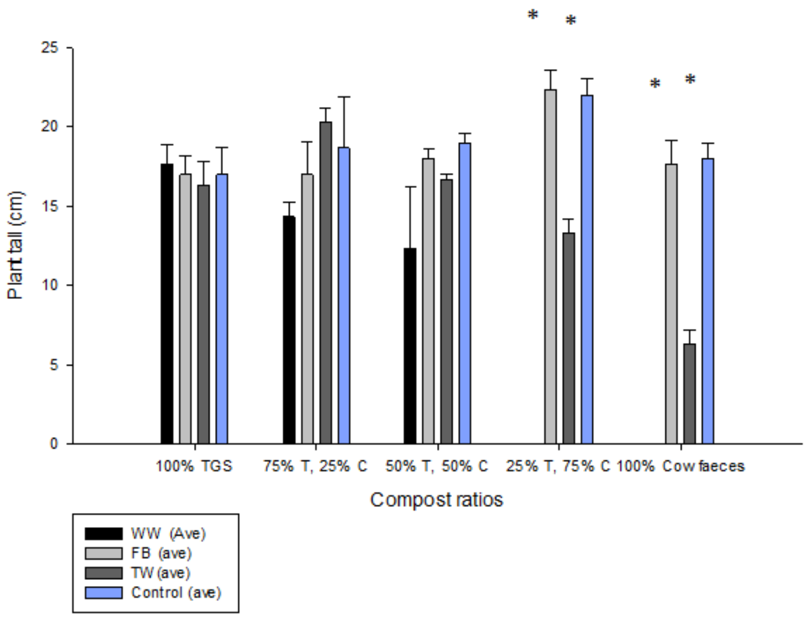

Fig. 3 Effect of cow faeces treated with FB, WW, TW and non-treated cow faeces on height of pea shoots grown in different compost ratios (Means of triplicate (±) SE log plant height (*Significant difference between group)

III. Results and Discussion

This study shows that the TW generally led to improvements in the plant growth parameters studied, especially in the compost-faeces ratio (75% compost, 25% cow faeces), followed by a ratio of 50% compost, 50% cow faeces, which showed significant differences for most measurements. Also the results of the statistical analysis showed significant differences between the TW and other larvae (FB, WW) as well as the control. In contrast, plant growth in WW treated faeces were weak compared with plants growth in compost treated by FB, WW and control, especially in the compost (25% compost 75% cow faeces) and 100% cow faeces where there was no growth at all (Fig. 2 B). The results show that the fresh plant weight, fresh leaf weight and fresh root weight were significantly higher in the compost treated by TW in 75% compost 25% cow faeces (Figs. 4-6). The results did not show evidence of any significant differences in the dry root weight between TW, WW, FB and control in all composts (Fig. 8). The control revealed increase in plant height and plant dry weight, showing significant differences in composts (25% compost, 75% cow faeces) and 100% cow faeces (Figs. 3 and 7). TW were shown to produce the best product when compared to that produced by WW, FB and the control, especially at the compost ratio of 75% compost, 25% cow faeces, followed by 50% compost, 50% cow faeces.

Reference [2] showed that the use of worms to treat animal wastes for use in the commercial culture of tomatoes (i.e. vermicomposting) is efficient for converting solid wastes to useful products. The incorporation of composts and vermicomposts into potting and container media was soon to be a potential use for these materials. They conducted a greenhouse trial where they determined the effects of a vermicompost produced from raw dairy manure (RDM) along with some other composting materials. All potting mixtures produced significantly higher biomass than the control. Others have also concluded that cow manure can be useful in potting compost [3], while [1] concluded that such manures can be useful in reducing the incidence of plant pathogenic fungi, such as *Phytopthora* species.

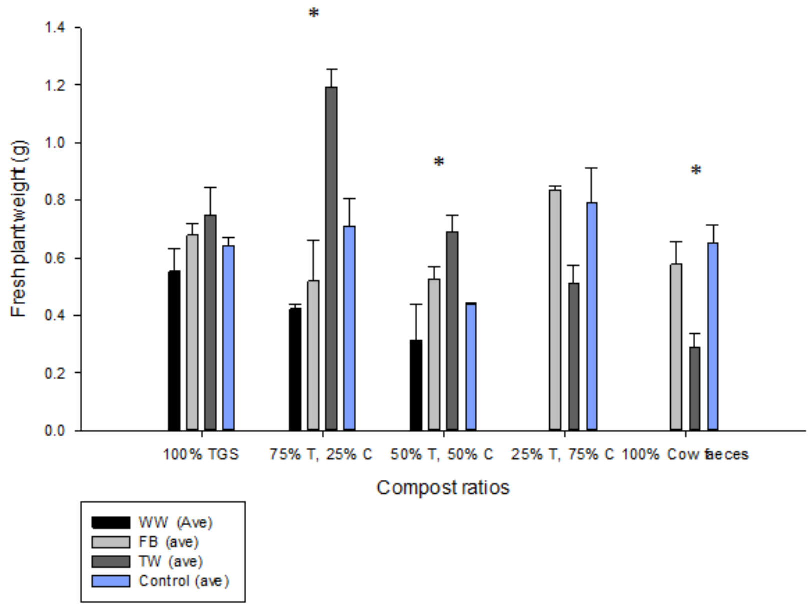

Fig. 4 Effect of cow faeces treated with FB, WW, TW and non-treated cow faeces on fresh plant weight of pea shoots grown in different compost ratios (Means of triplicate (±) SE log fresh plant weight (*Significant difference between groups)

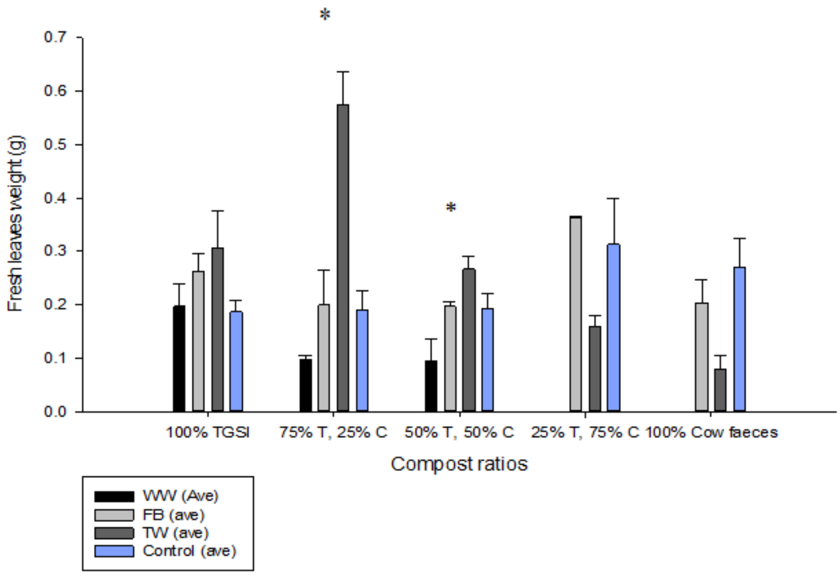

Fig. 5 Effect of cow faeces treated by FB, WW, TW and non-treated cow faeces on fresh leaves weight of peas grown in different compost ratios (Means of triplicate (±) SE log fresh leaves weight (*Significant difference between group)

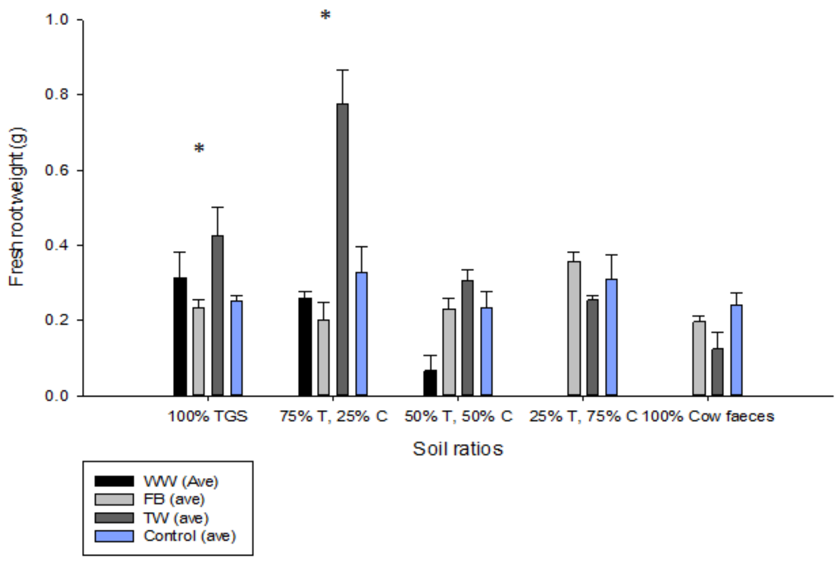

Fig. 6 Effect of cow faeces treated with FB, WW, TW and non-treated cow faeces on fresh root weight of peas grown in different compost ratios (Means of triplicate (±) SE log fresh roots weight (*Significant difference between groups)

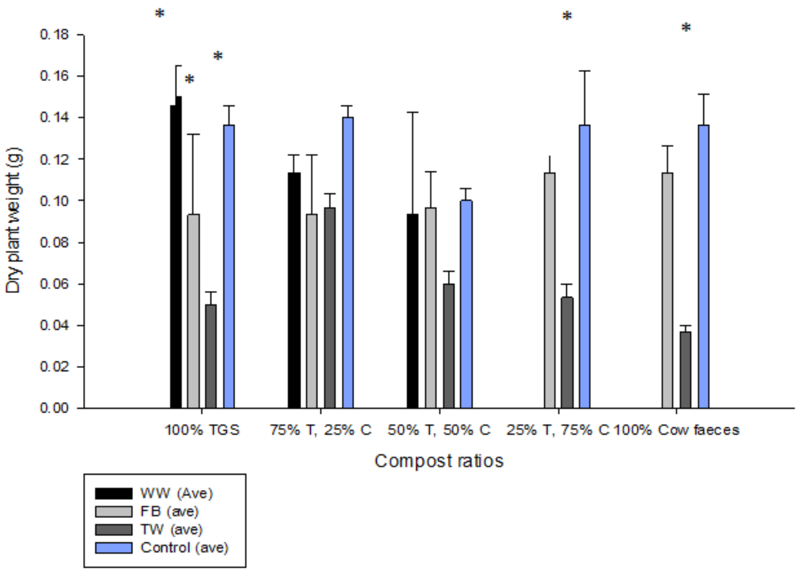

Fig. 7 Effect of cow faeces treated by FB, WW, TW and non-treated cow faeces on plant dry weight grown of peas in different compost ratios (Means of triplicate (±) SE log dry plant weight (*Significant difference between groups)

In conclusion, the results of this study show that pretreatrnent of cow faeces with the worms used here can improve the fertilizer potential of these materials such that they can become a potentially valuable additive to peat-based potting composts for use in households or horticulture. An important observation was made in relation to the odour of the cow faeces which was noticeably reduced following worm treatment. Such a reduction in odour has obvious benefits especially when the faeces are to be used as additives to household potting composts. The wide availability and cheapness of cow manure points to it being profitably used as a potting compost additive, and together with the fact that high protein-fat worms are produced as a byproduct, this means that the production process could be economically viable. Although peat based composts are the norm in the UK in the USA, and other countries, household potting composts are usually mineral soil-based [2].

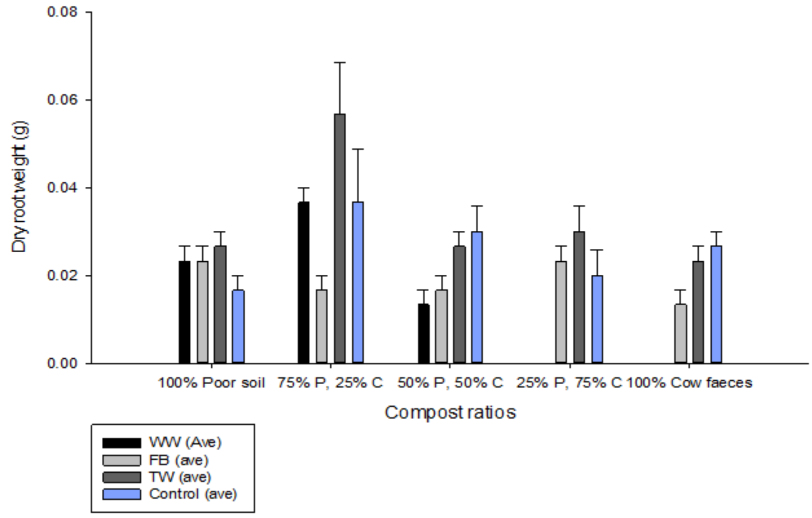

Fig. 8 Effect of cow faeces treated with FB, WW, TW and non-treated cow faeces on dry roots weight grown of peas in different compost ratios (Means of triplicate (±) SE log dry roots weight (*Significant difference between groups)

ACKNOWLEDGMENTS

The author gratefully thanks King Abdulaziz City for Science and Technology (KACST) for providing financial and other facilities for conducting the experiment.

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