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Full Length Research Paper

Studies on the Effect of Vermicompost on the Growth Yield and Quality of Chrysanthemum *(Chrysanthemum coronarium* L. *CV. Kasturba Gandhi)*

Subrata Raha
Head of the Department, Department of Botany, Raghunathpur College, Raghunathpur, Purulia. 723133. West Bengal. India

Abstract
Vermicompost is a nutrient-rich, microbiologically active organic amendment which results from the interactions between earthworms and microorganisms in the breakdown of organic matter. It is a stabilized, finely divided peat-like material with a low C: N ratio and high porosity and water-holding capacity that contain most nutrients in forms that are readily taken up by plants. Vermicompost is rich in NKP (nitrogen 2-3%, potassium 1.85-2.25% and phosphorus 1.55-2.25%) and also contain micronutrients, humic acid, plant growth hormones & enzymes. Incorporation of vermicompost has been shown to influence the physical properties of plant growing substrates. In this present trial different proportion of vermicompost was applied to a Chrysanthemums variety viz 'Kasturba Gandhi'. Experimental pots were filled by potting mixes prepared from vermicompost in three replicates in addition to control sets. The plant had shown best vegetative growth and flowering in 40% vermicompost and 60% basal media mixture. Considered collectively, the results of this study indicate that incorporation of vermicompost of animal origin into a traditional base medium of farm soil enhanced growth and flowering of potted Chrysanthemum plants. Vermicompost had a positive effects on fresh and dry weights of shoot, Leaf numbers, disease resistance, times to flowering, size, weight and duration of flower of Chrysanthemum compared to control media.

Key words: *Chrysanthemum, Vermicompost, Growth, Flowering, Soil improvement.*

Introduction

Conventional compost, Vermicompost and Chemical Fertilizers

All composts work as a 'slow-release fertilizer' whereas chemical fertilizers release their nutrients rather quickly in soil and soon get depleted. All compost are Produced from some 'waste materials' into a 'valuable resource'. It is of biological origin i.e. a 'renewable resource'. Chemical fertilizers are made from 'non-renewable' and a 'depleting' resource'. In the use of compost the environment is 'benefited' at all stages *i.e.* from production (salvaging waste & diverting them from landfills and reducing greenhouse gases) to application in farms (adding beneficial microbes to soil & improving biochemical properties). In the use of chemical fertilizers the environment is 'harmed' at all stages *i.e.* from procurement of raw materials from petroleum industries to production in factories (generating huge amount of chemical wastes and pollutants) and application in farms (adversely affecting beneficial soil microorganisms and soil chemistry).

Conventional composting and vermicomposting are quite distinct processes. Particularly with respect to optimum temperatures for each process and the type of decomposer microbial communities that predominate during active processing. Thermophilic bacteria predominate in conventional composting, mesophilic bacteria & fungi predominate in vermicomposting. Although the conventional composting process is completed in about 8 weeks, but additional 4 weeks is required for 'curing'. Compost that has had insufficient curing may damage crops. Vermicomposting takes nearly half the time of conventional composting and vermicompost do not require any curing and can be used straightway after production (Dominguez et.al., 1997). Vermicomposts have much 'finer structure' than ordinary compost and contain nutrients in forms that are readily available for plant uptake. Vermicomposts have outstanding chemical and biological properties with 'plant growth regulators' (lacking in other composts) and significantly larger and 'diverse microbial populations' than the conventional thermophilic composts (Galli and Tomati, 1995; Edwards, 2004). The conventional compost was higher in 'ammonium', while the vermicompost tended to be higher in 'nitrates', which is the more available form of nitrogen. vermicompost has higher N availability than the conventional compost on a weight basis and the supply of several other plant nutrients e.g. phosphorus (P), potassium (K), sulfur (S) and magnesium (Mg), were significantly increased by adding vermicompost as compared to conventional compost to soil (Atiyeh et.al.2000a; 2000b; 2000c). Vermicompost retains nutrients for long time and while the conventional compost fails to deliver the required amount of macro and micronutrients including the vital NKP (nitrogen, potassium & phosphorus) to plants in shorter time, the vermicompost does (Subler et. al., 1998; Hammermeister et.al., 2007).

Magic of vermicompost: The plant growth promoter and protector

Vermicompost is a nutritive 'organic fertilizer' rich in NKP (nitrogen 2-3%, potassium 1.85-2.25% and phosphorus 1.55-2.25%), micronutrients, beneficial soil microbes like 'nitrogen-fixing bacteria' and 'mycorrhizal fungi' (Kale and Bano, 1986). Additionally, vermicompost contain enzymes like amylase, lipase, cellulase and chitinase, which continue to break down organic matter in the soil to release the nutrients and make it available to the plant roots (Chaoui et. al., 2003). It is rich in humic acid, which enhance root growth and nutrient uptake. Vermicompost is free from toxic substances and works as a good soil conditioner. Vermicompost has very 'high porosity', 'aeration', 'drainage' and 'water holding capacity'. They have a vast surface area, providing strong absorbability and retention of nutrients. Retain more nutrients for longer period of time. Soil amended with vermicompost had significantly greater 'soil bulk density' and hence porous & lighter and never compacted. It also reduces demand for irrigation by nearly 30-40% (Nighawan and Kanwar, 1952; Lunt and Jacobson, 1994). The soil treated with vermicompost has significantly more electrical conductivity (EC) and near neutral pH (Tiwari et. al., 1989). Sever reports were published regarding it's positive influences on all yield parameters such as- improved seed germination, enhanced rate of seedling growth, flowering and fruiting of major crops like wheat, paddy, corn, sugarcane, tomato, potato, brinjal, spinach, grape and strawberry as well as of flowering plants like petunias, marigolds, sunflowers and poinsettias (Tomar et. al., 1998; Bhatia et. al., 2000; Atiyeh et. al., 2000b, 2002; Arancon et. al., 2006;). Vermicompost protects plants against various pests and diseases.

Materials and Methods

The experiment was conducted inside the J. C. Bose herbal garden situated inside our college campus The monthly meteorological data for the period of experimentation (August 2014 – February 2015) were recorded. The mean maximum temperature recorded was 32.5°C (August) and minimum temperature was 7.2°C (January). The mean relative humidity was maximum (90%) during the month of August and maximum rainfall (240.8 mm per month) was also recorded during August.

Experimental details are given as follows:
Genus: *Chrysanthemum*
Species: *coronarium*
Variety: *kasturba gandhi*
Treatments: seven
Number of replications: Three
Pot size: 12$^{//}$ Diameter X 8$^{//}$ height
Recommended fertilizer dose : 150:100:100 kg. N : P_2O_5: K_2O / ha.

The cultural operations like Nursery operations, Preparation of experimental pots, transplanting, fertilizers application, Post planting operations and Harvesting practices were done from time to time.

Six experimental sets (T2 – T7) with different ratios of basal media [a mixture of 70% farm soil and 30% sand (v/v)] and vermicompost were taken for the present study. All the pots were provided with balanced dose of NPK at the time of soil preparation only. Judicious application of trace elements was done in all the pots after 10 days of transplantation. Another control set (T1) was taken which was supplemented with proper dose of NPK and micronutrient, but without any trace of vermicompost (Table -1).

Table 1: Treatment details

Set	Composition
T1 (Control)	100 % Base Medium + NPK
T 2	10 % Vermicompost + 90 % Base Medium + NPK
T 3	20 % Vermicompost + 80 % Base Medium + NPK
T 4	30 % Vermicompost + 70 % Base Medium + NPK
T 5	40 % Vermicompost + 60 % Base Medium + NPK
T 6	50 % Vermicompost + 50 % Base Medium + NPK
T 7	60 % Vermicompost + 40 % Base Medium + NPK

Growth parameters like, plant height, average leaf area, dry matter production were collected and observations were also made on flowering, flower yield and yield attributes like days to flower bud initiation, duration of flower in pot, average weight of a fresh flower, diameter of flower, length of a floret, vas life of cut flower, shelf life of a flower.

Results

The result shows that the set T5 (40 % Vermicompost + 60 % Base Medium + NPK) is optimum for flowering and fitted best for commercial utilization. The T6 and T7 sets show a good vigor and luxuriant growth of the plant but with reduced floral features and thus unfit for commercial purpose. The plants of T5 sets not only flowered early with extended pot life but also bigger with higher vase and shelf life (Table 2).

Table 2: Comparison of vegetative and floral characters in different treatments.

Observations on growth parameters				Observations on flowering, flower yield and yield attributes						
Set. No.	Plant height (cm)	Average Leaf area (cm^2)	Dry matter production (g)	Days to flower bud initiation	Duration of flower in pot (Days)	Average weight of fresh flowers (g)	Diameter of flowers (cm)	Length of florets (cm)	Vase life of cut flowers (Days)	Shelf life of flowers (Hours.)
T 1	16.00	14.06	50.08	40	25	105.60	21.00	9.40	4.00	41.00
T 2	16.40	15.22	50.48	40	28	116.55	21.20	9.80	4.20	44.00
T 3	17.56	18.36	54.87	36	37	120.48	24.30	10.20	6.00	47.00
T 4	19.70	20.08	60.12	34	48	134.76	24.90	11.70	8.30	50.00
T 5	**21.24**	**23.40**	**65.34**	**32**	**52**	**154.65**	**28.30**	**13.80**	**9.00**	**51.00**
T 6	24.70	24.78	68.54	38	49	138.10	26.00	12.30	8.00	51.10
T 7	24.92	25.80	70.62	40	49	136.30	25.10	12.00	8.00	51.10

The plants with an optimum dose of vermicompost also exhibited a higher degree of resistance against fungal pathogens like *Cercospora chrysanthemi, Septoria chrysanthemella. Plants were also free from bacterial disease caused by Erwinia chrysanthemi* and less susceptible to Chrysanthemum aphid *viz. Macrosiphoniella sanborni.*

Discussion

The requirement of vermicompost for optimum yield may vary from species to species, but here addition of 40% vermicompost was found to be most suited for best yield. The increased rates of growth and flowering of Chrysanthemums could not have been associated with greater nutrient availability because, in all experiments, plants received all required nutrients from regular applications of NPK and micronutrients. Some possible factors that improved growth and flowering of Chrysanthemums could include vermicompost producing improvements in the physical structure of the growth medium such as aeration and drainage.

It could also have been due to biological effects such as increases in beneficial enzymatic activities, increased populations of beneficial microorganisms, or the presence of biologically active plant growth-influencing substances such as plant growth regulators or plant hormones in the vermicompost (Grappelli et al., 1987; Tomati and Galli, 1995; Subler et al., 1998) and humic acid (Arancon et al., 2006a). Krishnamoorthy and Vajranabhaiah (1986) showed that earthworm activity could promote the production of cytokinins and auxins in organic waste dramatically. Auxins and cytokinins produced by interactions between earthworms and microorganisms could persist in soil for up to 10 weeks but degraded rapidly if exposed to sunlight.

Plant growth hormones that are adsorbed on to humates would persist in soil and would be released slowly from humates and have much more effects on plant growth over a considerably longer period (Canellas et al., 2000).

Conclusion

The present work proves:

1. Application of vermicompost results in luxuriant growth and early flowering of large variety of Chrysanthemum (C.V. Kasturba Gandhi), reducing the maintenance cost.
2. The larger size, better shelf life and vase life of the flower due to application of vermicompost are valued more in the market.
3. Increased disease resistance of the plant.

Thus the application of vermicompost is strongly recommended for both gardening and commercial practices.

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