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INFLUENCE OF ORGANIC MANURES, BIO-FERTILIZERS AND GRADED DOSE OF INORGANIC FERTILIZERS ON THE GROWTH AND YIELD OF GINGER (*ZINGIBER OFFICINALE* ROSC.)

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Abstract

A field experiment was conducted to assess the performance of ginger treated with different combinations of organic and inorganic nutrition. A significant difference in the vegetative growth and rhizome yield was noticed when different combinations of organic and inorganic nutrition were tried. Among different combinations tried, maximum plant height (52.48 cm), number of leaves per tiller (17.57), pseudostem girth (1.27 cm) and number of tillers per clump (16.06) were observed in plants raised with Vermicompost + NPK75% + Azospirillum+VAM+PSB (T_5). Whereas, higher leaf length (20.27 cm), leaf breadth (2.16 cm) and leaf area (29.14cm^2) were observed in the plants raised with Compost + NPK100% + Azospirillum + VAM+PSB (T_1). Considering the projected yield per hectare, the highest yield (19.37 t) was produced from the plants raised with Vermicompost+NPK75%+Azospirillum+VAM+PSB (T_5). From Benefit : cost ratio point of view, the best treatment was observed in T_5 - Vermicompost+NPK75%+Azospirillum+VAM +PSB (4.09) followed by T_4 - Vermicompost + NPK75% + Azospirillum + VAM+PSB (3.83), clearly indicating the chance of saving 25 per cent inorganic fertilizers.

Key words : Ginger, organic, bio-fertilizer, growth, yield.

Introduction

Ginger (*Zingiber officinale* Rosc.) is one of the major spices produced and exported from India. The rhizome of ginger is used as a spice throughout the world besides its use in the alternative system of medicine and plays an important role in primary health care. Ginger is a herbaceous perennial, rhizomatous spice crop containing volatile and non-volatile compounds responsible for the characteristic pungency of the ginger rhizome. Ginger is a long duration and heavy feeder crop and responds well to manuring and gives high return per unit area; but removes large quantity of nutrients from the soil which require heavy input of fertilizers. Consistent and indiscriminate use of chemical fertilizers pollutes the environment, soil and water besides increasing the cost of production. Organic manures and bio-fertilizer improves growth and yield of ginger by increasing availability and uptake of nutrients, other micronutrients and production of growth promoting substance. Organic manures and biofertilizers offer as an alternative to chemical inputs and are being increasingly used in spice production today. On the other hand, biofertilizers are cost effective and renewable source of plant nutrients to supplement the part of chemical fertilizers. Biofertilizers are beneficial microorganisms which are one of the low cost inputs and have the ability to mobilize the nutrients from non-available to available form besides producing growth promoting and antifungal substances (Tien *et al.,* 1979; Sadanandan and Hamza, 1998; Jena and Das, 1997). Thus, they ensures saving a substantial amount of chemical fertilizers which eventually reduce the cost of production. In ginger, *Azospirillum* can reduce 50% of the recommended nitrogenous chemical fertilizers besides

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increasing fresh rhizome yield over recommended dose of chemical fertilizers. Therefore, keeping in view of the above facts, an experiment was conducted using nutrients from different organic and inorganic sources to work out their suitable integration for better growth and yield of ginger.

Materials and Methods

The experiment was conducted at Horticultural Research Station, Mondouri, B.C.K.V. for two consecutive years (2012-13). Topographical situation of the experimental site belongs to the Gangetic New Alluvial plains of West Bengal. The soil was sandy loam and slightly acidic in nature. In general the experimental site was having uniform fertility and good drainage facility and comes under sub-tropical humid climate as it is situated just south of tropic of cancer.. The experiment was laid out in Randomized Block Design with three replications. Three bio-fertilizers namely *Azospirillum,* VAM and PSB and three organic manures (compost, vermicompost and neemcake) were included as bio-organic inputs. The bio-fertilizers were applied in combination with organic manures and inorganic fertilizers. All together there are 19 treatments including one control without any treatments. After the final land preparation, compost @ 25 tonnes/ha, Vermicompost @ 2 tonnes/ha and Neemcake @ 3 tonnes/ha were applied along with recommended dose of fertilizers (NPK: 80: 50: 60 kg per ha) in the form of Urea, Single Super Phosphate and Muriate of Potash, respectively, either as full dose (100%) or at reduced rate (75% or 50% of RDF) according to treatment details. Nitrogen was applied in two split doses, the first dose as basal application and the other dose at 30 days after planting as top dressing. The entire dose of Phosphorus and Potash were applied at the time of sowing as basal dose. The Bio-fertilizers *viz*., *Azospirillum* @ 10 kg/ha, VAM @ 40 kg/ha and PSB @ 10 kg/ha) were mixed with organic manures and soil thoroughly and applied to the beds just before planting. The ginger variety 'Nadia' was used in the experiment. Ginger seed rhizomes of size 25 g each treated with *Trichoderma viride* (@ 5 g/kg seed rhizome) were planted on raised bed of size 3 × 1 m at a spacing of 30 cm × 25 cm. Mulching was done on the beds immediately after planting by using dried paddy straw as mulching materials. It is repeated 60 days later after weeding and top dressings as per treatment requirements. Earthing up was carried out to cover the exposed rhizome as and when necessary. Irrigation was provided immediately after planting and fertilizer application. Depending on the rainfall and soil moisture conditions, further irrigations were given as required. Hand weeding was done at an interval of 30 days from planting until the complete coverage of canopy. The crop was harvested after complete maturity as indicated by withering and drying up of leaves and tillers nine months after planting. Observations on growth parameters were recorded on five randomly selected clumps in each treatment at 180 days after planting and rhizome yield was recorded after harvest. Statistical analysis and interpretation of data was done as given by Panse and Sukhatme (1985). The level of significance used in 'F' and't' test was at P = 0.05. The economic analysis of different treatments was worked out based on corresponding cost of inputs and market prices.

Results and Discussion

Growth attributes recorded at 180 days after planting differed significantly among the different treatments (table 1.). The pooled data of two years showed that the plants raised with Vermicompost + NPK 75% + *Azospirillum* + VAM + PSB (T_5) produced significantly higher plant height (52.48 cm), number of leaves per tiller (17.57), pseudostem girth (1.27 cm) and number of tillers per clump (16.06) followed by T_8 (Neemcake + NPK 75% + *Azospirillum* + VAM + PSB) with a plant height of 50.74 cm, number of leaves per tiller (17.23), pseudostem girth (1.25 cm) and number of tillers per clump (15.77) compared to the lowest plant height (33.13 cm), number of leaves per tiller (8.80), pseudostem girth (0.81 cm) in T_{19} *i.e.*, control. Whereas, higher leaf length (20.27 cm), leaf breadth (2.16 cm) and leaf area (29.14cm^2) were observed in the plants raised with Compost + NPK 100% + *Azospirillum* + VAM + PSB (T_1). The combination of organic manures, biofertilizers along with 75 per cent of inorganic NPK performed better than other treatment combinations. Improvement in vegetative growth in these treatments might be attributed to combined effect of the organic and inorganic inputs which provided more assimilation of available nutrients to the plants (Sanwal *et al*., 2007). Application of organic manures improves soil tilth, aeration and water holding capacity of the soil besides stimulating the microorganisms that makes the plant food elements in the soil readily available to the crops. Vermicompost increases the growth rate because of better water and mineral uptake such as; nitrogen and phosphorus, which lead to the biological yield improvement (Atiyeh *et al*., 2002; Arancon *et al*., 2004). The inorganic fertilizers provide readily available nutrients at early growth stages while the organic manures release the nutrients slowly with constant supply of macro and micronutrients besides improving soil texture favorable for rhizome development (Dhasade *et al*., 2009). The

Table 1 : Effect of organic manures, biofertilizers and graded dose of fertilizers on growth and yield of ginger cv. Nadia (mean of 2 years).

Treatments	Plant height (cm)	Number of leaves/ tiller	Pseudo-stem girth (cm)	Leaf length (cm)	Leaf breadth (cm)	Leaf area (cm^2)	Number of tillers/ clump	Yield/plot (kg)	Yield/ hectare (t)	Cost lakh (Rs)	B:C ratio
T_1-C + NPK 100% + *Azos.* + VAM + PSB	45.69	14.67	1.21	20.27	2.16	29.14	14.50	4.11	17.45	2.05	3.25
T_2-C + NPK 75% + *Azos.* + VAM + PSB	49.66	16.64	1.24	17.97	1.99	23.88	15.47	4.42	18.80	2.04	3.60
T_3-C + NPK 50% + *Azos.* + VAM + PSB	39.96	12.32	1.15	16.77	1.87	20.97	13.10	3.28	13.94	2.03	2.43
T_4-VC + NPK 100%+*Azos.* + VAM + PSB	48.59	16.17	1.23	20.20	2.16	29.13	15.13	4.35	18.48	1.91	3.83
T_5-VC + NPK 75% + *Azos.* + VAM + PSB	52.48	17.57	1.27	19.13	2.07	26.31	16.06	4.56	19.37	1.90	4.09
T_6-VC + NPK 50% + *Azos.* + VAM + PSB	39.82	12.22	1.17	17.06	1.89	21.43	13.23	3.13	13.32	1.89	2.52
T_7-NC + NPK 100% + *Azos.* + VAM + PSB	46.09	15.49	1.22	20.04	2.15	28.74	14.87	4.27	18.14	2.08	3.35
T_8-NC + NPK 75% + *Azos.* + VAM + PSB	50.74	17.23	1.25	18.87	2.04	25.73	15.77	4.49	19.08	2.07	3.60
T_9-NC + NPK 50% + *Azos.* + VAM + PSB	40.44	12.74	1.17	17.19	1.88	21.47	13.09	3.12	13.26	2.04	2.25
T_{10}-NPK (100%) + C	41.88	13.51	1.20	17.50	1.92	22.38	13.77	3.45	14.67	2.04	2.60
T_{11}-NPK (100%) + VC	43.74	14.30	1.21	17.91	1.95	23.30	14.26	3.89	16.53	1.90	3.36
T_{12}-NPK (100%) + NC	42.21	14.08	1.20	17.72	1.92	22.70	13.89	3.58	15.23	2.07	2.69
T_{13}-NPK (75%) + C	38.78	11.31	1.13	16.69	1.84	20.44	12.74	2.52	10.70	2.02	1.64
T_{14}-NPK (75%) + VC	38.87	11.74	1.12	16.22	1.83	19.65	12.24	2.34	9.95	1.88	1.64
T_{15}-NPK (75%) + NC	38.20	11.16	1.03	16.05	1.83	19.60	11.98	2.20	9.33	2.05	1.27
T_{16}-NPK (50%) + C	36.90	10.72	0.91	15.28	1.78	18.15	10.30	1.87	7.93	2.01	0.97
T_{17}-NPK (50%) + VC	37.63	11.02	0.94	15.84	1.80	18.96	11.06	1.86	7.92	1.87	1.12
T_{18}-NPK (50%) + NC	36.60	10.57	0.89	15.21	1.78	18.03	10.82	1.74	7.39	2.04	0.81
T_{19}-Control	33.13	8.80	0.81	14.13	1.66	15.68	8.65	1.30	5.51	1.69	0.63
S.E.m.(±)	0.767	0.328	0.026	0.424	0.051	0.909	0.423	0.089	0.396	-	-
C.D.(P=0.05)	2.20	0.94	0.08	1.22	0.15	2.61	1.21	0.26	1.13	-	-

C= Compost, VC= Vermicompost, NC= Neemcake, *Azos*= *Azospirillum*, VAM= Vesicular arbuscular mycorrhiza, PSB= Phosphate solubilising bacteria

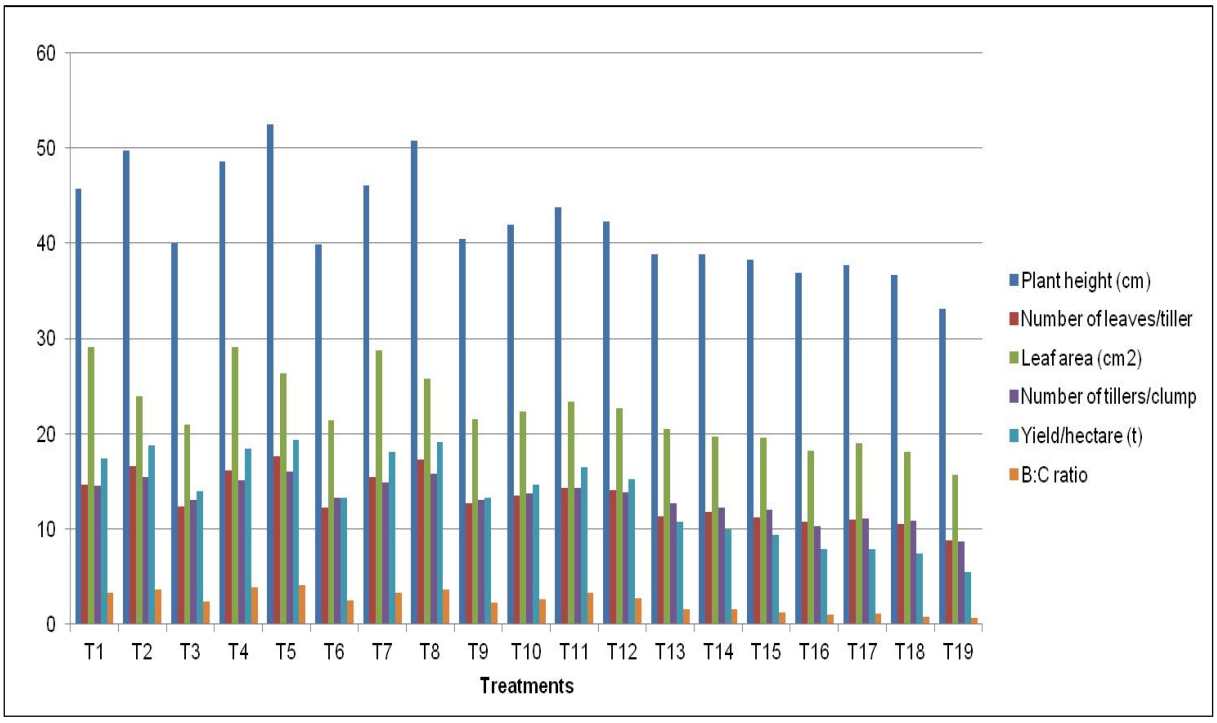

Fig. 1 : Effect of organic manures, biofertilizers and graded dose of fertilizers on growth and yield of ginger cv. Nadia.

present investigation revealed the increased growth attributes with the integrated application of organic and inorganic inputs which is similar to the findings of other workers in ginger (Sanwal *et al*., 2007; Jana, 2006).

From the pooled data it is evident that the treatment T_5 (Vermicompost + NPK 75% + *Azospirillum* + VAM + PSB) produced significantly higher yield per plot (4.56 kg) compared to the control - T_{19} (1.30 kg), however, it was statistically at par with T_8 (Neemcake + NPK 75% + *Azospirillum* + VAM + PSB) and T_2 (Compost + NPK 75% + *Azospirillum* + VAM + PSB) which produced 4.49 kg and 4.42 kg rhizome yield per plot, respectively. Higher projected yield per hectare (19.37 t) was recorded in the treatment T_5 (Vermicompost + NPK 75% + *Azospirillum* + VAM + PSB) which was closely followed by T_8 (Neemcake + NPK 75% + *Azospirillum* + VAM + PSB) and T_2 (Compost + NPK 75% + *Azospirillum* + VAM + PSB) which recorded fresh rhizome yield of 19.08 and 18.80 tonnes per hectare, respectively. The lowest yield was recorded in T_{19} - control (5.51 t). The experimental results clearly indicated that application of organic manures, biofertilizers viz. *Azospirillum,* VAM and PSB along with inorganic fertilizers proved to be effective in increasing the yield of ginger. The increase in yield was largely as a consequence of cumulative effect of the plant growth characters. Vermicompost application enhanced the activity of beneficial microbes like N_2 fixers and colonization by mycorrhiza fungi and hence play a significant role in N_2 fixation and phosphate mobilization leading to better uptake by plants (Kale *et al*., 1992). These findings are in good agreement with the observation of earlier workers on ginger (Jana, 2006; Singh and Singh, 2007).

Economic analysis indicated that the best treatment in terms of Benefit : cost ratio was observed in T_5 - Vermicompost + NPK 75% + *Azospirillum* + VAM + PSB (4.09) followed by T_4 - Vermicompost + NPK 100% + *Azospirillum* + VAM + PSB (3.83) and thus, clearly indicating the chance of saving 25 per cent inorganic fertilizers. Thus, an integrated approach of organic and inorganic nutrition can increase the growth and yield of ginger whereby the recommended dose of fertilizers can be reduced by the use of bio-fertilizers and organic manures.

References

Arancon, N. Q., C. A. Edwards, R. Atiyeh and D. M. James (2004). Effects of vermicomposts produced from food waste on the growth and yields of greenhouse peppers. *Bioresource Technol*., **93** : 139-144.

Atiyeh, R. M., S. Lee, C. A. Edwards, N. Q. Arancon and J. D. Metzger (2002). The influence of humic acids derived from earthworm-processed organic wastes on plant growth. *Bioresource Technol*., **84(1)** : 7-14.

Dhasade, K. K., A. A. Shaikh, M. M. Desai and R. S. Kamble (2009). Effect of organic manures and fertilizers on yield and nutrient uptake of ginger (*Zingiber officinale* Rosc.).

Bioinfolet., **6**(2) : 173-174.

Jana, J. C. (2006). Effect of *Azospirillum* and graded levels of nitrogenous fertilizer on growth, yield and quality of ginger (*Zingiber officinale* Rosc.). *Environment and Ecology*, **24S(Special 3)** : 551-553.

Jena, M. K. and P. K. Das (1997). Influence of microbial inoculants on quality of turmeric. *Indian Cocoa, Arecanut and Spices J*., **21(2)** : 31-33.

Kale, R. O., B. C. Mallesh, K. Bano and D. J. Basvaraj (1992). Influence of vermicompost application on the available micronutrients and selected microbial population in a paddy field. *Soil Biol. Biochem*., **24** : 1317-1320.

Panse, V. G. and P. V. Sukhatme (1985). *Statistical Methods for Agricultural Workers*. Indian Council of Agricultural Research, New Delhi.

Sadanandan, A. K. and S. Hamza (1998). Effect of organic farming on nutrient uptake, yield and quality of ginger (*Zingiber officinale*). In : *Water-and-nutrient-management for sustainable production and quality of spices*. Proceedings of the national seminar, Madikeri, Karnataka, India, 5-6 October, pp. 89-94.

Sanwal, S. K., R. K. Yadav and P. K. Singh (2007). Effect of types of organic manure on growth, yield and quality parameters of ginger (*Zingiber officinale*). *Indian J. Agric. Sci*., **77(2)** : 67-72.

Singh, V. B. and A. K. Singh (2007). Effect of types of organic manure and methods of nitrogen application on growth, yield and quality of ginger. *Environment and Ecology*, **25(1)** : 103-105.

Tien, T. N., M. H. Gaskins and D. H. Hubbell (1979). Plant growth substances produced by *Azospirillum brasilense* and their effect on growth of pearl millet. *Applied and Environment Microbiology*, **30** : 1016-1024.