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Effect of organic nutrient management on growth of ginger *variety* Suprava

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Abstract
Ginger is a key component in both conventional and modern medicine. It strengthens immunity and is a rich source of several minerals and physiologically active compounds. Since it can be grown in a variety of climatic circumstances, the production of this spice has been increasing in most regions of the world. Because it is a nutrient-exhaustive crop that needs an appropriate supply of nutrients at critical stages of its growth in the form of chemical fertilisers or organic manuring, or a combination of both. To obtain excellent quality and quantity of ginger rhizomes as well as protect soil health and environmental quality, effective nutrient management can aid in decreasing the abuse of chemical fertilisers. In this perspective, this chapter aims to depict, Nutrient Management for the sustainable production of ginger is a crucial component of sustainable agriculture, which necessitates resource management in a way to satisfy changing human requirements without degrading the quality of the environment and conserving essential natural resources. A field experiment was conducted at RRTTS, G. Udayagiri, Kandhamal, Odisha to assess the yield and quality of ginger treated with different combinations of organic manure. Bio fertiliser 12kg/ha +10 t FYM +4t leaf litter /ha + neem cake 2q/ha + pot manure was the best treatment with highest no of primary finger/clump (18.10), no of secondary fingers /clump(46.10), weight of primary finger/clump (366.79g), weight of secondary fingers /clump(265.14g) and yield of 154.11 q/ha in T6 among the treatments.Plant height at harvest is 74.20cm, no. of tillers/clump-12.3,no. of leaves/tiller - 16.30 and leaf length-15.12cm were found in T6. This combination also produced the highest net return 0f 332440 rupees with Benefit: Cost ratio of 2.56.

Keywords: Ginger, organic, bio-fertilizer, yield, quality

Introduction

Ginger (*Zingiber officinale* Rosc.) (Family: Zingiberaceae) is an herbaceous perennial, the rhizomes of which are used as a spice. Ginger is cultivated in most of the states in India. However, states namely Karnataka, Orissa, Assam, Meghalaya, Arunachal Pradesh and Gujarat together contribute 65 percent to the country's total production. Ginger (*Zingiber officinale* Rosc.) is one of the major spices produced and exported from India. Medicinal plants are a major source of traditional as well as modern medicine and play a major role in the world (Egamberdieva and Jabborova, 2020 [5], Jabborova *et al.*, 2021) [5, 12]. Ginger (*Zingiber officinale* Rosc.) is a spice and medicinal plant belonging to the Zingiberaceae family. Ginger has long been used in folk medicine in India and China. Especially, the wet and dry root of ginger is widely used in the medicine and food industry (Jabborova and Egamberdieva, 2019) [11]. It has been used in folk medicine for colds, sore throats, asthma, and joint pain and stimulates appetite (Egamberdieva and Jabborova, 2018) [4]. Ginger is also rich in beneficial nutrients for example phosphorus, potassium, and calcium, which play important roles in human physiological processes. These substances play an important role in boosting human immunity and maintaining health (Jabborova *et al.*, 2021 [12]. The dry rhizome of ginger is medicinal contains biologically active compounds. The rhizome contains carbohydrates, fats, proteins, vitamins, minerals, amino acids, monoterpenoids (camphene, sineiol, borneol, citral curcumin, and linalool), Gingerol, and sesquiterpenoids. The spice ginger is one of the most widely used species of the family Zingiberaceae. It is a common condiment for various foods and beverages (Jabborova *et al.*, 2021) [12]. Both fresh and dried ginger rhizomes are used worldwide as a spice, and ginger extracts are used extensively in the food, beverage, and confectionery industries (Jabborova and Egamberdieva, 2019 [11], *Zingiber officinale*, 2010).

The production of this spice has been expanding in most parts of the world, as it can be grown under varied climatic conditions.

The productivity of ginger is, however, affected due to poor nutrient management Dinesh *et al.*, 2012a) [3], as it is a nutrient-exhaustive crop and therefore requires an adequate supply of nutrients at important stages of its growth. Nutrient management options for this crop include inorganic or organic fertilizers or a mixture of both (Dinesh *et al.*, 2012b) [3]. Effective nutrient management can help in reducing the overuse of chemical fertilizers, thereby safeguarding environmental quality. However, there are very few reports on the influence of different nutrient schedules on ginger yield and quality.

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) [24, 19, 16]. Thus, they ensure 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 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 to work out their suitable integration for better yield and quality of ginger.

Materials and Methods

The experiment was conducted at Regional Research Technology and Transfer Station (RRTTS), G Udayagiri, Kandhamal, Odisha for two consecutive years (2021-22). The experiment was laid out in Randomized Block Design with three replications.

Treatments

- **T_1:** Bio-fertiliser (consortia) +10 t FYM,
- **T_2:** Bio-fertiliser (consortia) +10 t FYM +4t leaf litter /ha
- **T_3:** Bio-fertiliser (consortia) +10 t FYM +4t maize stover /ha
- **T_4:** Bio- fertiliser (consortia) +10 t FYM +4t leaf litter /ha +neem cake 2q/ha
- **T_5:** Bio-fertiliser (consortia) +10 t FYM+4t maize stover /ha +neem cake 2q/ha
- **T_6:** Bio-fertiliser (consortia) +10 t FYM +4t leaf litter /ha +neem cake 2q/ha + pot manure
- **T_7:** Bio-fertiliser (consortia) +10 t FYM+4t maize stover /ha +neem cake 2q/ha +pot manure

Pot manure: Extract of cow dung 5 kg + cow urine 5 litre + 1 kg of leaf each *of Pongamia pinnata, Calotropis gigantea and Azadirachta Indica* + 250 gm of Gaggery fermented for 15 days to be sprayed 4 times at 15 days interval.

Soil Properties: Texture - Clay loam having pH- 6.8, O.C.- 0.72%, Available N -218 kg/ha (low), Available P-26.1 kg/ha (Medium) and available K- 276 kg/ha (Medium) and Zinc 0.32mg/kg (Low).

The ginger variety 'Suprava' 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 x 1 m at a spacing of 30 cm x 25 cm. Mulching was done on the beds immediately after planting by using sal leaves 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 yield parameters were recorded in each treatment after harvest. The economic analysis of different treatments was worked out based on corresponding cost of inputs and market price.

Results and Discussion

The effect of different treatments on the yield and quality of ginger are presented in Table 1, 2 and 3. Significant results were obtained on yield parameters such asBio fertiliser 12kg/ha +10 t FYM +4t leaf litter /ha +neem cake 2q/ha + pot manure was the best treatment with highest no of primary finger/clump (18.10), no of secondary fingers/clump (46.10), weight of primary finger/clump (366.79g), weight of secondary fingers /clump (265.14g) and yield of 154.11 q/ha in T6 among the treatments. Plant height at harvest is 74.20cm, no. of tillers/clump-12.3, no. of leaves/tiller -16.30 and leaf length-15.12cm were found in T6. This combination also produced the highest net return of 332440 rupees with Benefit: Cost ratio of 2.56. Combined application of organic manures, biofertilizers had beneficial effect on yield and yield attributing characters. The increase in yield was largely as a consequence of cumulative effect of the plant growth characters (Singh and Singh, 2007) [23]. Among the organic manures, the combinations where vermicompost was applied produced better performance and higher yield than Neemcake and Compost. The findings are in good agreement with the observations of earlier workers in ginger (Jana, 2006; Sanwal *et al.*, 2007; Dash *et al.*, 2008 and Rana and Korla, 2010) [15, 22, 18]. Studies to monitor the response of ginger to irrigation and nutrient management have not been seriously undertaken in the past. The present study suggests that irrigation at 0.9 IW/CPE accompanied by 75% RDF as inorganic fertilizers + 25% RDF as vermicompost was the best treatment combination for achieving higher ginger rhizome yield, quality parameters and maximum water productivity in the Indo-Gangetic Inceptisols. The study also revealed a high impact on the ginger rhizome yield owing to soil water stress and an imbalance of soil available nutrients (Sanmay *et al.* 2022) [21].

The improvement in quality in these treatments may be attributed to the organic inputs (organic manures and biofertilizers) along with inorganic fertilizers which improved the physico-chemical and biological properties of the soil which enable roots to proliferate resulting in better utilization and absorption of NPK and micronutrients required for enhancing the quality of the rhizome. The results in this study are in accordance with the observation of earlier workers who reported similar findings in ginger (Rana and Korla, 2010 [18]; and Jana, 2006) [15]. Dash *et al.*, (2008) reported that biofertilizers have a positive bearing in enhancing the quality of ginger. Sanwal *et al.*, (2007) [22] reported that the oleoresin content of ginger treated with different organic manures were higher compared to sole inorganic application. Sadanandan *et al.*, (2002) [20] also reported that application of organic manure and biofertilizers increased the oleoresin content in ginger.

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

Treatments	No of primary fingers/clump	No of secondary fingers/clump	Weight of primary fingers/clump (gm)	Weight of secondary fingers/clump
T_1	12.39	31.75	291.23	199.23
T_2	13.75	32.79	302.18	209.03
T_3	14.01	33.41	299.75	207.01
T_4	16.71	38.23	320.95	223.18
T_5	16.43	36.13	310.15	213.01
T_6	18.10	46.12	366.79	265.14
T_7	17.23	41.71	341.19	244.51
SE (m) +	0.67	1.06	3.40	2.85
CD (0.05)	2.20	3.20	9.80	8.70

Table 2: Effect of organic nutrient management on growth of ginger *var*. Suprava (Pooled over 2021-22 &2022-23)

Treatments	Plant Height at harvest (cm)	No of tillers/clump	No of leaves/ tiller	Leaf length (cm)	Leaf breadth (cm)
T_1	55.29	6.02	8.47	13.01	2.40
T_2	65.21	7.13	10.19	13.71	2.52
T_3	62.41	6.61	9.2	13.45	2.45
T_4	69.19	8.60	12.20	14.21	2.68
T_5	66.10	7.81	11.45	14.01	2.53
T_6	74.20	12.3	16.30	15.12	3.06
T_7	73.107	10.11	14.10	14.43	2.78
SE (m) +	1.50	0.16	0.19	0.33	0.07
CD (0.05)	4.30	5.1	0.59	1.44	0.20

Table 3: Effect of organic nutrient management on yield and economics of Ginger *var*. Suprava ((Pooled over 2021-22 &2022-23)

Treatments	Yield (kg/ha)	Gross return (Rs/ha)	Net return (Rs/ha)
T1	120.17	480671	193603
T2	128.45	513805	229604
T3	123.10	492409	207845
T4	141.19	565161	281160
T5	134.20	536800	252899
T6	154.11	616442	332440
T7	148.23	592927	307891
SE (m) +	2.60	6145.22	5151
CD (0.05)	5.58	17340.12	11048

In the present study also the plants raised with the integration of organic manures (leaf litter, neemcake FYM, pot mannure), bio-fertilizers (consortia) resulted in higher content of quality parameter and yield.
Thus, an integrated approach of organic nutrients can increase the yield and quality of ginger.

Conclusion
Bio-fertiliser 12kg/ha +10 t FYM +4t leaf litter /ha +neem cake 2q/ha + pot manure produced the highest yield when compared with other treatments.
Profitability - Bio-fertiliser 12kg/ha +10 t FYM +4t leaf litter /ha +neem cake 2q/ha + pot manure gave the highest net return and benefit cost ratio over other treatments.

Future Research
MLTs can be taken and popularisation of the technology by conducting OFT and FLDs through KVK and Govt. Line Department.

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