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Yield and economics of gingercultivation under soppinabetta ecosystem of Karnataka

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Abstract
The experiment was conducted to assess yield and economics of ginger (*Zingiberofficinale*Rosc.) cultivation under Soppinabetta ecosystem of Karnataka. The experiment was laid out in a randomized block design (RBD) fashion with 16 treatments replicated twice. The investigation indicated that the Humanabad Local was the most promising genotype in terms of yield and economics. It has recorded highest yield per plant (360.20g), yield per plot (8.08kg) and fresh rhizome yield per hectare (21.55 ton) which was on par with IISR-Mahima. Genotype Humnabad Local also recorded maximum dry recovery (27.35%) which was on par with IISR- Mahima (25.10%), Rio-de-Janeiro (24.80%) and Karkala Local (24.03%).Highest cost-benefit ratio was recorded in genotype Humnabad Local (Rs.4.918) and the least cost-benefit ratio was recorded in genotype Jorhat-1 (Rs.2.407). Higher cost-benefit ratio is attributed to the increase in fresh rhizome yield of the genotype.

Keywords: ginger, evaluation, yield, cost-benefit ratio.

Introduction
The rhizome of ginger (*Zingiberofficinale*Rosc.) is one of the most widely used spice of the family Zingiberaceae. India is the largest ginger producing country in the world and is cultivated in most of the Indian states. In India, it is grown in an area of 1,65 lakh hectares with an annual production of 10.81 lakh MT with productivity of 6.57 MT per hectare [1]. Many varieties of ginger are available in India which are region specific, varying in plant habit, yield and quality parameters. The performance of ginger grown in Soppinabetta ecosystem of Utara Kannada district of Karnataka has shown an immense potential for its commercial cultivation in large area. However, the information on varieties suitable to this region is scanty and no systematic efforts were made to evaluate the improved ginger cultivars for their suitability to this region and economics of cultivation. Hence, the present investigation was under taken to identify a suitable variety or varieties with better benefit cost ratio for Utara Kannada and surrounding regions of costal and south India for commercial cultivation at college of Horticulture Sirsi, Uttara Kannda district of Karnataka.

Material and methods
The field experiment was carried out at the farm field of College of Horticulture, Sirsi, Karnataka during 2014-2015. The College of Horticulture, Sirsi is located at 14.26° North latitude and 74.5° East longitudes at an altitude of 619 meters above mean sea level. It receives an annual average rainfall of 2353 mm. The mean maximum temperature is 35.10˚ C (May) and mean minimum temperature is 15.50˚ C (January) and the relative humidity ranges from 64 to 93.80 per cent. The experiment conducted in a red sandy loam soil with moderate fertility level having pH5.67. The trials were laid out in randomized block design (RBD) with two replications using sixteen genotypes of ginger namely IISR-Mahima, IISR-Varada, IISR-Rajatha, Suravi, Suprabha, Himagiri, Rio-de-Janeiro, Suruchi, Himachal, Karkal Local, Humanabad Local, Jorhat-1, Jorhat-2, Bidar-1, Bidar-2 and Shikaripura Local were selected for the study. Raised bed of 3 m length and 1m width and 15 cm height was prepared. The ginger rhizomes were planted with a spacing of 30 cm × 20 cm. The land was applied with FYM (farm yard manure) at 25 tonnes per hectare, vermicom post at 2 tonnes per hectare and

recommended dose of P and K (50:50 kg P and K/ha) at the time of land preparation. Recommended N (100 kg/ha) was applied in split doses, 50 percent of the N was applied one month after the planting and remaining 50 percent of the N was applied one month after the first application. Cultivation practices were followed as per recommended package of practices [2]. The crop was harvested when leaves started withering by digging out the rhizomes after drying up of leaves which indicated complete maturity. Harvested rhizomes were cleaned to remove adhering soil and sticking roots. Five randomly chosen plants in each replication of each entry were labeled and used for recording the observations *viz.*, fresh yield per plant (g), fresh rhizome yield per plot (kg), fresh rhizome yield per hectare (t), dry ginger recovery (%) and dry ginger yield per hectare (t). The dry ginger recovery was measured by soaking known quantity of fresh rhizomes in water for 6 hours and adhering scales were removed, and the rhizomes were dried until constant weight was obtained and expressed in percentage by using the following formula.

$$\text{Percentage of dry ginger recovery} = \frac{\text{Weight of dried ginger}}{\text{Weight of fresh ginger}} \times 100$$

The harvest index was calculated on dry weight basis by dividing weight of rhizome per clump with total weight of biomass produced per clump, as for the formula given by Donald (1962) [3] and expressed in percentage.

$$\text{HI}(\%) = \frac{\text{Economic yield (g/plant)}}{\text{Biological yield (g/plant)}}$$

Duration from the date of planting to the date when more than sixty percent of the clumps in a treatment showed withering and drying of foliage was accounted to days taken for maturity and expressed in days. Based on number of days taken for maturity, crop duration was classified as short duration varieties (100−120 days), medium duration (120−140 days) and long duration (160 days plus).

The data collected were subjected to statistical analysis. For determination of standard error of mean (S.Em.±) and critical difference (C.D) between the treatment means at 5% level of significance, the statistical table formulated by Panse and Sukhatme [4] was referred.

Economics of cultivation is calculated by calculating total cost of cultivation, total income and net income. Total cost of cultivation was calculated for cost of fertilizers, manures, plant protection chemicals, labour, land rental value and wages for all the cultural practices pertained during the experimental year and expressed (Rs/ha). Total income (Rs/ha) was computed by multiplying total fresh weight of rhizome per hectare and average price prevailed in the market. Net income is worked out by subtracting total cost of cultivation from total income. Finally Benefit to Cost ratio was worked out to know the feasibility of economics of cultivation. It was computed by dividing the gross income from the total cost of cultivation *i.e*.

$$\text{Benefit Cost ratio} = \frac{\text{Gross income}}{\text{Total cost of cultivation}}$$

Results and Discussion

The data on yield attributes are presented in table 1. There was a significant difference among the genotypes for all the yield attributes. The genotype Humnabad Local recorded the highest yield per plant (360.20g) which was on par with Cv. IISR- Mahima (325.40 g) and the lowest yield per plant was recorded in the genotype Jorhat-1 (180.50g). Per plant rhizome yield varied from152 g per plant to 201.00g per plant among ten ginger cultivars grown under West Bengal condition was also reported [5]. The fresh rhizome yield per plot differed significantly among the genotypes. The genotype Humnabad Local recorded the highest yield (8.08 kg) which was on par with Cv. IISR- Mahima (7.14 kg) and Bidar-1 (7.10 kg) whereas, lowest yield was in the genotype Jorhat-1 (3.96 kg). The genotype Humnabad Local recorded the highest yield per hectare (21.55 ton), which was on par with IISR- Mahima (19.45 ton) and the lowest yield per hectare was recorded in the genotype Jorhat-1 (10.55ton).Variation in yield among different cultivers under different growing condition also reported by Chongtham *et al*. (2013) [5] under Southern West Bengal condition. Where, cultivar Goruba than recorded highest rhizome yield per hectare (18.27 ton) followed by Sambuk local (14.74 ton).Curing is an important post-harvest operation in dry ginger preparation, which involves treating rhizomes in limewater and drying to get finished product. The ultimate cured yield depends on the maturity of the crop and fiber content. Significant variation in curing percentage was observed among the varieties under present study. The genotype Humnabad Local recorded the maximum dry recovery (27.35%) and dry rhizome yield (5.89 t/ha) which was on par with the genotype IISR- Mahima (25.10%) and (4.78t/ha) and the lowest was recorded in the genotype Jorhat-1 (17.17%) and (1.81t/ha). Such variation in curing percentage from 26.90% (Suprabha) to 33.48% (Sambuk local) also reportedin ginger under Southern West Bengal condition [5]. The genotype Humnabad Local recorded the higher harvest index (0.56) which was at par with IISR- Mahima (0.54), Karkala Local (0.54), Shikaripura Local (0.54), Suprabha (0.53), Suravi (0.53) and IISR- Rajatha (0.52) and least was recorded in the genotype Jorhat-1 (0.46). The performance of genotypes revealed the inherent capacity of the genotypes evaluated in similar conditions.In the present investigation, crop duration varied significantly among different genotypes (198 to 240 days) from planting to upto harvest. The variation is attributed due to differential maturity and growth habit of the genotypes.The genotype Karkala Local recorded higher crop duration (240 days), Humanabad Local (233 days), Himagiri (230 days) Rio-de-Janeiro (230 days), Bidar-1 (230 days) and Bidar-2 (230 days) were on par with each other taking more number of days to mature, while genotype IISR- Rajatha (198 days), IISR- Varada and IISR- Mahima (200 days), genotype Jorhat-1 (215 days), and Himachal (218 days) took less number of days to harvest.The duration of the total growing season has an enormous influence on the seasonal crop water need. Based on the maturity the genotypes IISR-Rajatha, IISR-Mahima, IISR-Varada, Jorhat-1 and Jorhat-2, are found to be of short duration type (196-215days), while genotypes, *viz.*, Humnabad Local, Shikaripura Local, Himagiri, Suravi, Bidar-2, Karkala Local were found to bemedium duration types (225-240 days). Such variation in crop duration was also recorded and confined by Hrideek *et al.* (2006) [6] at higher elevation of Western Ghats and [7] under Muzaffarpur condition in turmeric.

The higher fresh rhizome yield in the genotypes Humnabad Local is attributed to the growth parameters like plant height, number of leaves per plant and number of tillers per plant and the study indicated that the local genotype also have the potential to perform better by following standard package of practices.

Benefit Cost ratio is an important and ultimate parameter which decides the optimum level of input to be used in production of any crop. In the present study, the cost benefit ratio for different genotypes was worked out and represented in Table 2. Maximum cost-benefit ratio was obtained in genotype Humnabad Local (Rs. 4.918), followed by the genotype IISR- Mahima (Rs.4.438). The least cost-benefit ratio was recorded in genotype Jorhat-1 (Rs. 2.407) higher cost-benefit ratio is attributed to the increase in fresh rhizome yield of the genotype. These results are in agreement with findings of [8], [9] and [10] in Turmeric**.**

Table 1: Yield attributes and crop duration in different ginger genotypes under Soppinabetta ecosystem

Sl. No.	Genotypes	Fresh rhizome yield (g/plant)	Fresh rhizome yield (kg/plot)	Fresh rhizome yield (t/ha)	Dry rhizome yield (t/ha)	Recovery (%)	Harvest index	Number of days to harvest	Crop duration
1	Suprabha	222.60	6.82	18.18	3.80	20.88	0.53	225.00	Medium
2	IISR-Mahima	325.40	7.14	19.45	4.78	25.10	0.54	200.00	Short
3	Karkala Local	309.00	4.58	12.20	2.93	24.03	0.54	240.00	Medium
4	Humnabad Local	360.20	8.08	21.55	5.89	27.35	0.56	233.00	Medium
5	Himagiri	208.50	4.34	11.58	2.36	20.40	0.48	230.00	Medium
6	IISR-Varada	259.10	6.90	18.40	4.06	22.09	0.43	200.00	Short
7	Suravi	298.20	6.50	17.33	3.90	22.51	0.53	228.00	Medium
8	Shikaripura Local	309.00	6.90	18.40	4.16	22.59	0.54	228.00	Medium
9	Suruchi	309.00	7.00	18.67	3.57	19.15	0.45	222.00	Medium
10	Jorhat-1	180.50	3.96	10.55	1.81	17.17	0.44	215.00	Short
11	Himachal	244.95	6.95	18.53	3.95	21.32	0.48	218.00	Short
12	Rio-de-Janeiro	199.70	7.01	18.70	4.64	24.80	0.50	230.00	Medium
13	IISR-Rajatha	251.85	6.97	18.58	3.73	20.07	0.52	198.00	Short
14	Bidar-1	290.70	7.10	18.94	3.51	18.54	0.49	230.00	Medium
15	Jorhat-2	268.70	6.78	18.09	3.70	20.46	0.46	215.00	Short
16	Bidar-2	317.50	7.00	18.69	3.80	20.35	0.50	230.00	Medium
	S.Em ±	12.12	0.33	0.71	0.37	1.52	0.02	4.46	
	CD (0.05)	36.52	1.01	2.10	1.11	4.56	0.05	13.46	
	CV (%)	12.85	11.19	10.03	12.00	11.13	4.99	12.15	

Table 2: Economics for different ginger genotypes grown under Soppinabetta ecosystem (for one hectare area)

Sl.No.	Genotypes	Cost of cultivation (₹/ha)	Yield (ton ha^{-1})	Gross return (₹ ha^{-1})	Net return (₹ha^{-1})	B:C ratio
		A	B	C= B X market price	D = C – A	E = C/A
1	Suprabha	241020.45	18.18	999900.00	758879.55	4.149
2	IISR-Mahima	241020.45	19.45	1069750.00	828729.55	4.438
3	Karkala local	241020.45	12.20	671000.00	429979.55	2.784
4	Humnabad local	241020.45	21.55	1185250.00	944229.55	4.918
5	Himagiri	241020.45	11.58	636900.00	395879.55	2.643
6	IISR-Varada	241020.45	18.40	1012000.00	770979.55	4.199
7	Suravi	241020.45	17.33	953150.00	712129.55	3.955
8	Shikaripura local	241020.45	18.40	1012000.00	770979.55	4.199
9	Suruchi	241020.45	18.67	1026850.00	785829.55	4.260
10	Jorhat-1	241020.45	10.55	580250.00	339229.55	2.407
11	Himachal	241020.45	18.53	1019150.00	778129.55	4.228
12	Rio-de-Janeiro	241020.45	18.70	1028500.00	787479.55	4.267
13	IISR-Rajatha	241020.45	18.58	1021900.00	780879.55	4.240
14	Bidar-1	241020.45	18.94	1041700.00	800679.55	4.322
15	Jorhat-2	241020.45	18.09	994950.00	753929.55	4.128
16	Bidar-2	241020.45	18.69	1027950.00	786929.55	4.265

Market price of fresh ginger as on April 2015, ₹55 per kg of fresh rhizome**.**

Conclusion

Among the different genotypes evaluated, the genotype Humnabad Local yielded highest yield per plant, per plot and yield per hectare and also the genotype Humnabad Local exhibited better benefit cost ratio as compared to all other genotypes**.** Hence, it can be recommended for commercial cultivation in Uttara Kannada area of Karnataka and adjoining states of southern India**.**

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