International Journal of Bio-resource and Stress Management https://pphouse.org/ijbsm.php

Crossref

IJBSM June 2022, 13(6):630-637 Print ISSN 0976-3988 Online ISSN 0976-4038 Article AR2780a

Research Article Natural Resource Management

DOI: HTTPS://DOI.ORG/10.23910/1.2022.2780a

Performance Evaluation of Ginger Genotypes on their Yield and Nutrient Uptake under the Coastal Karnataka, India

Ravi Y.[1&2], Narayanpur V. B.[1], Gangadharappa P. M.[1], Hiremath J. S.[1], Shantappa T.[3], Prashant A.[4] and Doddamani M. B.[5]

[1]Dept. of Spices, Plantation, Medicinal and Aromatic Crops, [4]Dept. of Plant Pathology, [5]Dept. of Genetics and Plant Breeding, University of Horticultural Sciences, Bagalkot, Karnataka (587 104), India
[2]ICAR-National Research Centre on Seed Spices, Ajmer, Rajasthan (305 206), India
[3]RHREC, Dharwad, University of Horticultural Sciences, Bagalkot, Karnataka (587 104), India

Open Access

Corresponding ravinaiky@gmail.com

0000-0003-2540-7037

ABSTRACT

A field experiment was conducted during *kharif* (June, 2014–January, 2015) at College of Horticulture, Sirsi, Karnataka, India to study the yield, yield attributing traits, nutrient content and nutrient uptake pattern in ginger genotypes. In the present study 16 ginger genotypes including nationally released varieties viz. 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 with an aim to assess the yield performance of selected genotypes and varieties in order to determine nutrient content and absorption pattern. Research results indicate that among 16 ginger genotypes including national released varieties the genotype Humnabad Local has recorded maximum number of primary rhizomes (6.30) and secondary rhizomes (24.50), higher fresh rhizome yield (360.20 g plant^{-1}) and yield ha^{-1} (21.55 t ha^{-1}), dry recovery (27.35%). The genotype Bidar-1 recorded highest nitrogen content in rhizome (1.49%), whereas the variety IISR-Mahima recoded highest nitrogen content in root (1.16%) and in shoot (1.60%). Genotype Shikaripura local recorded maximum phosphorus content in rhizome (0.41%), root (0.39%) and in shoot (0.59%). Genotype Humnabad Local recorded highest potassium content in root (2.57%), whereas the variety IISR-Mahima recorded highest potassium content in rhizome (2.58%) and shoot (2.56%). The nutrient uptake pattern of ginger genotypes indicates that the ginger crop is potassium and nitrogen exhaustive. The results of this study provide a guideline for fertilizer application to ginger crop with respect to varieties, quantity and proportion of nutrient elements according to the demand of variety.

KEYWORDS: Ginger, genotypes, nutrient uptake, yield

Citation (VANCOUVER): Ravi et al., Performance Evaluation of Ginger Genotypes on their Yield and Nutrient Uptake under the Coastal Karnataka, India. *International Journal of Bio-resource and Stress Management*, 2022; 13(6), 630-637. HTTPS://DOI.ORG/10.23910/1.2022.2780a.

Copyright: © 2022 Ravi et al. This is an open access article that permits unrestricted use, distribution and reproduction in any medium after the author(s) and source are credited.

Data Availability Statement: Legal restrictions are imposed on the public sharing of raw data. However, authors have full right to transfer or share the data in raw form upon request subject to either meeting the conditions of the original consents and the original research study. Further, access of data needs to meet whether the user complies with the ethical and legal obligations as data controllers to allow for secondary use of the data outside of the original study.

Conflict of interests: The authors have declared that no conflict of interest exists.

RECEIVED on 14th December 2021 RECEIVED in revised form on 10th May 2022 ACCEPTED in final form on 12th June 2022 PUBLISHED on 30th June 2022

1. INTRODUCTION

Ginger (*Zingiber officinale* Rosc.; Zingiberaceae) rhizomes both fresh and dried are used as a spice all over the world (Mao et al., 2019), possess several medicinal properties (Singh and Kumar, 2021). It is an integral component of homesteads in Kerala and coastal regions of Karnataka (Sudha et al., 2020), valued for pleasant spicy aroma (Prasad and Tyagi, 2015) and has multifarious uses viz. confectionery (Saiah et al., 2018), ginger cordial and ginger candy (Yeah et al., 2014), ginger wine and beer (Wei et al., 2017), pickles etc. (Ravi et al., 2017). The total area accounts in India under ginger cultivation is 176.34 thousand ha which associate in annual production of 1886.53 metric tonnes (Malhotra et al., 2021). To maintain soil fertility and productivity, it is vital to nourish the soil with organic manures as well as chemical fertilisers in the optimum amount and balance (Biswasi et al., 2020). Intensive agriculture with insufficient and unbalanced use of chemical fertilisers, unfriendly tillage techniques (Kalegore et al., 2018; Bordoloi et al., 2021) has resulted in substantial fertility deterioration of our agricultural soils and improper soil functioning (Sharma et al., 2019). It is consequently critical to manage the soil environment appropriately in order to ensure a good crop stand and increase resource-use efficiency (Singh et al., 2020; Sarita and Mehriya, 2022). Nutrient management (Samant et al., 2021), in addition to soil type, is crucial for maximum ginger growth and output (Srinivasan et al., 2019). Understanding accurate nutrition is critical for improving nutrient usage efficiency and minimising overuse of and fertiliser (Kumar et al., 2021). The nutrient management techniques used to cultivate a crop are likely to have an impact on not just the crop's biomass production (Dinesh et al., 2012) but, also its quality, soil quality, and overall cultivation costs (Jagtap et al., 2018). Like every alternative plant, ginger needs the proper type of nutrients to excel in its growth and yield. Major nutrient elements are the source for plant growth and development (Kaur et al., 2020) and are associated with reproductive growth (Kaur et al., 2020), particularly under humid atmospheric condition wherever rainfall is high and nutrient reserves are moderate to low due to natural actions like erosion effects and leaching losses (Faroque et al., 2020; Mahapatra et al., 2022). A common phenomenon rather than an exception, like every plants, ginger crop also need optimum nutrients to excel in its growth, yield and yield attributing characters. Ginger is an exhaustive crop and requires heavy manuring (Neog et al., 2022) and determination of the optimum nutrient level is extremely important in fulfilling the genetic yield potential of crops under certain geographical conditions (Saikishore et al., 2021). Earlier works of fertilizer studies (Srinivasan et al., 2019; Saraswati et al., 2016) showed that rhizomatic crops are fertilizer responsive crop and yield augmentation is possible with enhanced fertilizer application. This spice's production has been increasing in most parts of the world, because it can be grown in a variety of climates and effective application of nutrients can play a major role reduce the usage of chemical fertilisers, protecting the environment without compromising the quality (Jabborova et al., 2021). Chemical fertilisation, organic manuring, or a combination of inorganic fertilisers and organic manures are all nutrient management strategies for the crops (Manju and Pushpalatha, 2022). Little information available on nutrient content and their uptake pattern in ginger varieties. Hence, the present investigation was undertaken to assess yield, nutrient proportion and nutrient absorption pattern in different ginger genotypes under coastal Karnataka condition.

2. MATERIALS AND METHODS

The field experiment was conducted during *kharif* June, 2014–January, 2015 at College of Horticulture, Sirsi, Karnataka, India to assess the performance of available ginger varieties to recommended dose of chemical fertilizers under coastal ecosystem. The Horticulture collage at Sirsi, is located at 14.26° North latitude and 74.5° East longitudes at an elevation of 619 meters above mean sea level in coastal region of Karnataka, India. The experimental location receives an annual average rainfall of 230 cm. The mean maximum temperature of about 35.10°C is experienced during month of May month with mean minimum temperature (15.50°C) during January month. The relative humidity ranged from 64–93.80%. The soil of the study area is red sandy loam with moderate fertility level having pH of 5.67. Before the establishment of ginger crop, the experimental land was applied with FYM (25 t ha^{-1}) and mixed with soil at the time of land preparation. Recommended dose of NPK (chemical fertilizers) at the rate of 100:50:50 kg ha^{-1} was applied along with vermicompost at the rate of 2 t ha^{-1}. Cultivation practices were followed as per recommended cultural practices (Anonymous, 2018). The experimental plots were maintained at a proper moisture level to ensure better germination of planted ginger rhizomes. In this study, a total of 16 ginger genotypes including national released varieties were used and laid out in randomized block design (RBD) with two replications. The Physico-chemical properties of the experimental soil are as follows; pH 5.6, EC 0.72 dSM^{-1}. Rhizomes weighing 25–30 g each were planted at a spacing of 30×20 cm^2 apart at a depth of 5 cm in a raised bed size of 3×1 m^2. The data on yield and yield attributes were recorded after harvesting of the crop and presented in table 1.

2.1. Determination of available nutrients in soil

2.1.1. pH and electrical conductivity (ds m^{-1})

Soil pH was measured in 1:2.5 soil water suspension using

Table 1: Yield attributes of studied ginger genotypes

Sl. No.	Genotypes	No. of primary rhizomes	No. of secondary rhizomes	Fresh yield g $plant^{-1}$	Fresh yield ton ha^{1}	Dry recovery (%)
1.	Suprabha	4.60	20.53	222.60	18.18	20.88
2.	IISR-Mahima	6.05	22.75	325.40	19.45	25.10
3.	Karkala local	5.90	21.90	309.00	12.20	24.03
4.	Humnabad local	6.30	24.50	360.20	21.55	27.35
5.	Himagiri	4.50	20.68	208.50	11.58	20.40
6.	IISR-Varada	4.23	21.30	259.10	18.40	22.09
7.	Suravi	3.80	20.80	298.20	17.33	22.51
8.	Shikaripura local	3.70	21.19	309.00	18.40	22.59
9.	Suruchi	4.60	21.75	309.00	18.67	19.15
10.	Jorhat-1	3.36	18.83	180.50	10.55	17.17
11.	Himachal	4.60	21.05	244.95	18.53	21.32
12.	Rio-de-Janeiro	4.40	20.78	199.70	18.70	24.80
13.	IISR-Rajatha	4.70	20.40	251.85	18.58	20.07
14.	Bidar-1	4.50	21.54	290.70	18.94	18.54
15.	Jorhat-2	3.70	19.00	268.70	18.09	20.46
16.	Bidar-2	4.20	20.10	317.50	18.69	20.35
	SEm±	0.49	0.86	12.12	0.71	1.52
	CD (p=0.05)	1.47	2.59	36.52	2.10	4.56

pH meter (Systronic model). After the pH measurement the suspension was kept (undisturbed) overnight. The electrical conductivity of the suspension was measured by inserting the conductivity cell of the EC Bridge (Systronic model) in the supernatant solution. Available nitrogen: The available soil nitrogen content was determined by modified Kjeldahl's method suggested by Jackson (1973). Available phosphorus (P): Available soil phosphorus was measured by using O.5 M $NaHC0_3$ (Jackson, 1973). Available potassium (K): Soil potassium content was extracted using neutral N NH_40AC as described by Schollenberger and Simon (1945). The K concentration in the extractant was determined by flame photometer (McLean, 1982) and was expressed in kg ha^{-1}.

2.1.2. Plant nutrient content estimation

For this purpose, five plants in each treatment were randomly selected, uprooted during harvesting (180 days after planting) and separated into different parts (leaf, stem and rhizomes). Then, the collected samples were dried in hot air oven at 65°C temperature, till constant weight was attained. The NPK content from powdered samples were measured as described by Jackson (1973), and their uptake (NPK) was calculated by using biomass estimation. The uptake of nutrients in different parts of the plant was worked out by multiplying the percent content of respective nutrient with dry matter of respective part.

2.1.3. Statistical analysis

The data collected were subjected to statistical analysis by following Panse and Sukhatme (1967) for determination of standard error of mean (SEm±) and critical difference (C.D.).

3. RESULTS AND DISCUSSION

3.1. Ginger rhizome yield and yield attributes influenced by recommended dose of fertilizers

A perusal of data presented in Table 1 shows highly significant variations among the genotypes for yield and yield attributes like number of primary rhizome, number of secondary rhizome, fresh ginger yield per plant, fresh rhizome yield per hectare, and dry ginger recovery in per cent. The number of primary and secondary rhizomes per plant differed significantly among the sixteen genotypes evaluated. Maximum number of primary rhizomes were recorded in genotype Humnabad Local (6.30) which was on par with IISR- Mahima (6.05) and Karkala Local (5.90) whereas, the minimum number of primary rhizomes was recorded in the Jorhat-1 (3.36). The number of secondary rhizomes per plant differed significantly among the genotypes. The maximum number of secondary rhizomes per plant was recorded in genotype Humanabad Local (24.50), which was statistically on par with IISR- Mahima

Tab

(22.75). The minimum number of secondary rhizomes per plant was recorded in the genotype Jorhat-1 (18.83). The genotype Humnabad Local recorded the maximum yield per plant and yield per hectare (360.20 g and 21.55 t ha^{-1}) respectively, which was on par with IISR- Mahima (325.40 g and 19.45 t) respectively and the lowest was recorded in the genotype Jorhat-1 (180.50 g and 10.55t) respectively. The genotype Humnabad Local recorded the maximum dry recovery (27.35%) which was on par with the genotype IISR- Mahima (25.10%), Rio-de-Janeiro (24.80%) and Karkala Local (24.03%). The lowest dry recovery percentage was recorded in the genotype Jorhat-1 (17.17%). For study traits, a significant level of variation was identified in different accessions. Better development and greater yield components contributed positively to this genotype's better rhizome production. Similar variation in ginger rhizome yield per pant has also been reported by Anargha et al. (2020) where the accession Kazhakootam has reported 150.40 g $pant^{-1}$ and 30.84 g $plant^{-1}$ fresh and dry rhizome yield respectively under Kerala condition. Higher yield components contribute positively to crop plant yield. As a result, the superiority may be linked to yield contributing features impacted by the nutrient uptake pattern.

3.2. Plant NPK content

From the Table 2 it was observed that nutrient contents in different parts of the ginger were significantly influenced by ginger genotypes Among the genotypes, genotype Bidar-1 contained the highest amount of nitrogen in rhizome (1.49%) and variety Surachi recorded the least nitrogen content (1.12%) in rhizome. Root (1.16%) and shoot (1.60%) highest nitrogen content was achieved by variety IISR-Mahima. On the other hand, the lowest nitrogen content in root and shoot was found in genotypes Jorhat-2 (0.30%) and IISR-Varada (1.16%). Interestingly, genotype Shikaripura local contained the highest phosphorus in all the parts viz., rhizome (0.41%), root (0.39%) and shoot (0.59%) whereas, the least phosphorus content in root (0.21%) and rhizome (0.23%) was found in variety IISR-Varada. Rio-de-Janeiro has recorded the lowest potassium content in shoot (0.39%). In case of potassium content, genotype Humnabad Local's root contained the highest potassium (2.57%), whereas the variety IISR-Mahima's rhizome (2.58%) and shoot (2.56%) recorded highest potassium content. Lowest amount of potassium content in root was observed in the variety Rio-de-Janeiro (2.16%) while, the variety Himachal recorded lowest potassium content in rhizome (2.18%) and shoot (2.16%). The difference in NPK contents in different plant parts of ginger genotypes in this study might be due to genetic inheritance capacity of the genotype to absorb nutrients from the soil and fertility status of soil. Our results

Table 2: Nitrogen, phosphorus and potassium content (%) in different parts of ginger genotypes under Soppinabetta ecosystem

Genotype	Nitrogen (%)			Phosphorus (%)			Potassium (%)		
	Root	Rhizome	shoot	Root	Rhizome	Shoot	Root	Rhizome	Shoot
Suprabha	0.68	1.22	1.24	0.37	0.33	0.53	2.53	2.41	2.36
IISR-Mahima	1.16	1.49	1.60	0.24	0.39	0.55	2.44	2.58	2.56
Karkala local	0.73	1.13	1.21	0.34	0.37	0.52	2.44	2.44	2.38
Humnabad local	0.64	1.29	1.32	0.32	0.31	0.56	2.57	2.54	2.49
Himagiri	0.48	1.14	1.24	0.31	0.30	0.45	2.53	2.49	2.40
IISR-Varada	0.67	1.15	1.16	0.21	0.26	0.41	2.42	2.36	2.34
Suravi	0.37	1.16	1.23	0.23	0.32	0.42	2.39	2.37	2.34
Shikaripura local	0.56	1.23	1.24	0.39	0.41	0.59	2.48	2.48	2.41
Suruchi	0.08	1.12	1.21	0.33	0.28	0.43	2.28	2.49	2.46
Jorhat-1	0.58	1.33	1.27	0.32	0.34	0.44	2.34	2.51	2.47
Himachal	0.58	1.35	1.38	0.26	0.28	0.43	2.17	2.18	2.16
Rio-de-Janeiro	0.77	1.23	1.32	0.23	0.23	0.39	2.16	2.32	2.19
IISR-Rajatha	0.39	1.39	1.52	0.27	0.28	0.43	2.31	2.42	2.26
Bidar-1	0.45	1.52	1.47	0.28	0.29	0.44	2.30	2.31	2.25
Jorhat-2	0.30	1.40	1.22	0.25	0.34	0.46	2.35	2.37	2.36
Bidar-2	0.60	1.28	1.54	0.30	0.34	0.54	2.30	2.39	2.34
SEm±	0.06	0.08	0.07	0.02	0.02	0.04	0.15	0.04	0.05
CD (p=0.05)	0.18	0.23	0.20	0.07	0.06	0.11	0.45	0.12	0.14

is in agreement with Nagarajan and Pillai (1979) who have reported such variation in N, P and K contents in rhizomes and shoots of Rio-de-Janeiro, Wynad local, Maran, China and Narasapattanam genotypes of ginger. Similar results of variability among the genotypes have also been reported by earlier studies by Rao and Swamy (1984), Chloke (1993). The data on uptake of different nutrients (NPK) from the soil have been significantly influenced by different genotypes of ginger and is depicted in Table 3. The genotype IISR-Mahima have taken the maximum quantity of nitrogen through rhizome (9.93 g bed^{-1}), roots (1.45 g bed^{-1}) and in shoot (8.22 g bed^{-1}). The least amount of nitrogen uptake in root (0.08 g bed^{-1}) and rhizome (5.59 g bed^{-1}) was achieved by Suruchi and in shoot (5.01 g bed^{-1}) by Jorhat-1. The rhizome (2.66 g bed^{-1}) and shoot (3.21 g bed^{-1}) of genotype Shikaripura Local and roots of the genotype Karkala Local (0.42 g bed^{-1}) removed highest phosphorus from the soil. The root (0.21 g bed^{-1}), rhizome (1.38 g bed^{-1}), and shoot (1.70 g bed^{-1}) of genotypes Jorhat-2, Suruchi and Jorhat-1, respectively, removed least phosphorus from the soil. Humnabad Local's rhizome (18.43 g bed^{-1}) and shoot (13.96 g bed^{-1}) and root of Rio-de-Janeiro (3.36 g bed^{-1}) have used the maximum amount of potassium in soil. Whereas, the rhizome of Bidar-1 (9.75 g bed^{-1}), shoot of Himachal (9.66 g bed^{-1}), and roots of Shikaripura Local (1.82 g bed^{-1}) had removed the minimum amount of potassium from the soil. Such variation with respect to nutrient removal by different ginger genotypes was also reported by other workers (Murulidharan 1973; Mohanty et al., 1993). On an average, the highest soil available NPK uptake was performed by IISR-Mahima (19.60 g bed^{-1}), Shikaripura Local (6.22 g bed^{-1}) and Humnabad Local (34.59 g bed^{-1}), respectively. On the contrary, least soil available nitrogen (12.44 g bed^{-1}), phosphorus (3.77 g bed^{-1}) and potassium (22.48 g bed^{-1}) was found in genotypes Suruchi, Rio-de-Janeiro and Bidar-1 genotypes of ginger, respectively. Such kind of variability is attributed by difference in nutrient content of plant parts and variation in fresh and dry matter production. Maximum soil available nitrogen was recorded after harvest in the variety Rio-de-Janeiro and genotype Bidar-1 (94.83 kg ha^{-1}), genotype Bidar-1 recorded maximum soil available phosphorus (64.37 kg ha^{-1}) and

Table 3: Uptake of Nitrogen, phosphorus and potassium in different ginger genotypes

Genotype	Nitrogen (g bed^{-1})			Phosphorus (g bed^{-1})			Potassium (g bed^{-1})			Total uptake of nutrients (g bed^{-1})		
	Root	Rhizome	shoot	Root	Rhizome	shoot	Root	Rhizome	Shoot	N	P	K
Suprabha	0.64	7.50	5.82	0.34	2.00	2.47	2.43	14.82	11.10	13.96	4.81	28.35
IISR-Mahima	1.45	9.93	8.22	0.29	2.57	2.4	3.05	17.25	12.17	19.60	5.26	32.47
Karkala local	0.92	6.59	5.37	0.42	2.17	2.47	3.05	14.30	10.54	12.88	5.06	27.89
Humnabad local	0.64	9.34	7.43	0.50	2.01	2.50	2.60	18.43	13.56	17.41	5.01	34.59
Himagiri	0.53	7.15	5.95	0.33	2.10	2.09	2.66	15.60	11.61	13.63	4.52	29.87
IISR-Varada	0.70	6.24	6.17	0.21	1.42	2.19	2.53	12.83	12.50	13.11	3.82	27.86
Suravi	0.38	7.56	6.32	0.29	2.31	2.16	2.48	15.52	12.08	14.26	4.76	30.08
Shikaripura local	0.41	8.07	6.76	0.35	2.66	3.21	1.82	15.62	13.20	15.24	6.22	30.64
Suruchi	0.08	5.59	6.77	0.29	1.38	2.32	2.56	12.48	13.34	12.44	3.99	28.38
Jorhat-1	0.48	7.74	5.01	0.27	1.96	1.70	1.98	14.68	9.81	13.23	3.93	26.47
Himachal	0.83	7.73	6.20	0.37	1.72	1.91	3.12	13.57	9.66	14.76	4.00	26.35
Rio-de-Janeiro	1.19	8.05	6.13	0.41	1.58	1.78	3.36	15.19	10.20	15.37	3.77	28.75
IISR-Rajatha	0.47	7.63	6.93	0.32	1.44	2.12	2.78	12.68	11.38	15.03	3.88	26.84
Bidar-1	0.42	6.41	6.94	0.26	1.63	2.06	2.16	9.75	10.57	13.77	3.95	22.48
Jorhat-2	0.25	6.24	6.00	0.21	1.50	2.24	2.00	10.57	11.60	12.49	3.95	24.17
Bidar-2	0.63	6.11	7.77	0.31	1.64	2.70	2.42	11.47	11.75	14.51	4.65	25.64
SEm±	0.02	0.19	0.18	0.02	0.13	0.03	0.03	0.17	0.25	0.39	0.18	0.45
CD (p=0.05)	0.05	0.59	0.56	0.07	0.38	0.10	0.08	0.50	0.77	0.50	0.55	1.35

potassium (622.46 kg ha^{-1}). The least soil available nitrogen (71.75 kg ha^{-1}), phosphorus (23.95 kg ha^{-1}) and potassium (408.35 kg ha^{-1}) was recorded in genotypes Karkala Local, Bidar-2 and IISR-Mahima respectively (Table 4). This is due to the difference in nutrient content of plant parts and variation in fresh and dry matter production. The findings support the increased N, P, and K content as well as the uptake pattern was reported in ginger by Ajithkumar and Jayachandran (2001). The nutrient uptake pattern of ginger genotypes under this study indicated that ginger crop has the potentiality of exhaustive use of potassium and nitrogen from the soil. This may be because ginger is rhizomatous plant and mostly such plants utilize more of potash and nitrogenous fertilization.

Table 4: Nutrient status of soil after harvesting in different ginger genotypes

Genotype	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
Suprabha	87.31	34.62	466.10
IISR-Mahima	84.80	27.44	408.35
Karkala Local	71.75	29.44	486.78
Humnabad Local	88.06	42.91	541.37
Himagiri	84.80	34.93	538.07
IISR-Varada	80.03	34.93	551.23
Suravi	87.06	39.92	582.36
Shikaripura Local	76.77	59.38	601.66
Suruchi	85.55	39.92	561.46
Jorhat-1	93.83	37.42	519.72
Himachal	93.33	52.39	568.60
Rio-de-Janeiro	94.83	26.45	524.91
IISR-Rajatha	91.32	49.40	530.01
Bidar-1	94.83	64.37	622.49
Jorhat-2	91.82	24.95	596.19
Bidar-2	94.58	23.95	506.77
SEm±	5.62	7.55	20.86
CD (p=0.05)	16.94	22.76	62.87
Initial value	220.77	91.81	884.35

4. CONCLUSION

The genotype Humnabad Local and variety IISR-Mahima had significantly higher yield plant^{-1} and hectare^{-1} coupled with yield-attributing traits than the other screened varieties and genotypes. Further, the nutrient uptake pattern of ginger genotypes had indicated that the ginger crop was potassium and nitrogen exhaustive. The variety IISR-Mahima had absorbed the maximum quantity of nitrogen and the local genotypes Shikaripura Local and Humnabad Local had drawn the highest amounts of phosphorus and potassium from the soil. Further, the exotic introduction, Rio-de-Janeiro, had performed better for the highest amount of soil available nitrogen and the local genotype Bidar-1 for phosphorus and potassium.

5. REFERENCES

Anonymous, 2014. Improved package of practices for horticultural crops (Kannada) University of Horticultiral Sciences, Bagalkot, Karnataka. Pp.170–176. Available at https://uhsbagalkot.in/documents/Horticulture_POP[1].pdf. Accessed on 7/05/2022.

Biswasi, S.K., Barik, A.K., Bastia, D.K., Dalei, B., Nayak, L., Ray, M., 2020. Effect of Integrated Nutrient Management on Growth, Productivity and Economics of Hybrid Maize in Odisha State. International Journal of Bio-resource and Stress Management 11(1), 465–471.

Bordoloi, A., Sarmah, A.S., Pathak, P.K., 2021. Soil nutrient status in different tea gardens of Tinsukia district of Assam. International Journal of Economic Plants, 8(1), 143–148.

Dinesh, R., Srinivasan, V., Hamza, S., Manjusha, A., Sanjay Kumar, P., 2012. Short-term effects of nutrient management regimes on biochemical and microbial properties in soils under rainfed ginger (*Zingiber officinale* Rosc.). Geoderma 173–174, 192–198.

Faroque, A.A., Paul, A.K., Asaduzzaman, B.P., Islam, M.S., 2020. Effect of next generation fertilizers on growth and yield potential of Maize (*Zea mays* L.). International Journal of Economic Plants 7(1), 151–155.

Jabborova, D., Sayyed, R.Z., Azimov, A., Jabbarov, Z., Matchanov, A., Enakiev, Y., Baazeem, A., Ayman, E.L., Sabaghg, Subhan, D., Datta, R., 2021. Impact of mineral fertilizers on mineral nutrients in the ginger rhizome and on soil enzymes activities and soil properties. Saudi Journal of Biological Sciences 28(9), 5268–5274.

Jackson, M.L., 1973. Soil chemical analysis. Pretence hall of India Pvt. Ltd., New Delhi, 111–192.

Jagtap, D.N., Mahadkar, U.V., Chavan, L.S., Burondkar, M.M., Dhekale, J.S., Dhane, S.S., Pinjari, S.S., Jadhav, M.S., 2018. Effect of different crop establishment methods and fertilizer sources on growth, yield attribute and yield of rice (*Oryza sativa* L.). International Journal of Economic Plants, 5(1), 174–180.

Kalegore, N., Gavhane, M.A., Bhusari, S.A., Kasle, S.V., Dhamane, R.S., 2018. Response of Cowpea (*Vigna unguiculata*) to inorganic and biofertilizers. International Journal of Economic Plants 5(1), 167-169.

Kaur, P., Singh, S.K., Kaur, R., Sidhu, M.K., 2020. Response of different levels of nitrogen and spacing on growth and yield of Cauliflower grown under central region of Punjab. International Journal of Bio-resource and Stress Management 11(1), 320–326.

Kumar, P., Sinha, A., Lata, S.S., Singh, D., 2021. Standardization of fertilizer application through drip system as compared to conventional method of basin fertigation in Orange. International Journal of Economic Plants 8(1), 025–028.

Mahapatra, S., Chakraborty, S., Samanta, M., Das, S., 2022. Impacts of integrated nutrient management on epidemiology, seed yield and severity of Alternaria blight disease in Indian mustard (*Brassica juncea* L.). International Journal of Bio-resource and Stress Management 13(1), 299308.

Mao, Q.Q., Xu, X.Y., Cao, S.Y., Gan, R.Y., Corke, H., Beta, T., Li, HB. , 2019. Bioactive Compounds and Bioactivities of Ginger (*Zingiber officinale* Roscoe). Foods 8(6), 185.

Malhotra, S.K., Cheriyan, H., Meena, B., Manojkumar, K., Sruthi, S., 2021. Spices statistics at a glance 2021, Directorate of Arecanut and Spices Development, Calicut, Kerala.

Manju, P.R., Pushpalatha, P.B., 2022. Effect of organic nutrients on the yield and quality of Banana cv. Nendran (*Musa* spp., AAB). International Journal of Bio-resource and Stress Management 13(1), 179–186.

McLean, O., 1982. Soil pH and lime requirements. Methods of soil analysis: chemical and microbiological properties, 2nd ed. ASA, SSS, Madison, WI. pp. 199–224.

Mohanty, D.C., Sarma, Y.N., Panda, B.S., Edison, S., 1993. Studies on fertilizer management and seed rates in ginger variety Suruchi. Indian Cocoa, Arecanut & Spices Journal 16(304), 101–104.

Nagarajan, M., Pillai, N.S., 1979. A note on nutrient removal by ginger and turmeric rhizomes. Madras Agricultural Journal 66, 56–59.

Neog, P., Goswami, R.K., Saikia, D., Gogoi, N., Klaita, M.K., 2022. Response of modifed microclimates on growth, yield, and incidence of rhizome rot disease of ginger in Assam, India. International Journal of Biometeorology 66, 719–730.

Panse, V.G., Sukhatme, P.V., 1967. Statistical methods for agricultural workers. Indian Council of Agricultural Research, New Delhi, 155.

Prasad, S., Tyagi, A.K., 2015. Ginger and its constituents: role in prevention and treatment of gastrointestinal cancer. Gastroenterology Research and Practice, 2015, 142979.

Rao, D.V.R., Swamy, G.S., 1984. Studies on the effect of N, P and K on growth, yield and quality of turmeric. South Indian Horticulture 35(5), 288–291.

Ravi, Y., Narayanpur, V.B., Hiremath, J.S., Ravi, J.P., Shantappa, T., 2017. Evaluation of ginger (*Zingiber officinale* Rosc.) genotypes for growth and yield attributes under soppinabetta ecosystem of Karnataka. Environment and Ecology 35(1B), 454–457.

Saikishore, A., Rekha, K.B., Hussain, S.A., Madhavi, A., 2021. Grain yield, nutrient uptake and post-harvest soil properties of browntop millet under varying sowing windows and nitrogen levels. International Journal of Bio-resource and Stress Management 12(1), 541–551.

Saiah, W., Halzoune, H., Djaziri, R., Tabani, K., Koceir, E.A., Omari, N., 2018. Antioxidant and gastroprotective actions of butanol fraction of *Zingiber officinale* against diclofenac sodium-induced gastric damage in rats, Journal of Food Biochemistry 42, e12456

Samant, T.K., Garnayak, L.M., Paikaray, R.K., Mishra, K.N., Swain, S.K., 2021. Effect of nutrient management and Rice establishment methods on Groundnut (*Arachis hypogaea* L.) in Rice–Groundnut cropping system. International Journal of Bio-resource and Stress Management 12(1), 663–669.

Saraswati, S.S., Mastiholi, A.B., Sakhubai, H.T., Ravi, Y.,

2016. Uptake of NPK Influenced by different organic manures on medicinal coleus (*Plectranthus forskohlii* Willd.) cultivar K-8. Ecology Environment and Conservation 22(2), 161–164.

Sarita, S.I., Mehriya, M.L., 2022. Influence of different levels of fertilizer and post-emergence herbicides on weed control efficiency, nutrient depletion by weeds and production of wheat (*Triticum aestivum* L.). International Journal of Bio-resource and Stress Management 13(1), 309–316.

Schollenberger, C.J., Simon, R.H., 1945. Determination of exchange capacity and exchangeable bases in soil-ammonium acetate method. Soil Science 59(1), 13–24.

Sharma, P., Singh, M., Bhardwaj, S., 2019. Effect of management practices on soil nutrient status of Apple orchards in Kullu district of Himachal Pradesh. International Journal of Economic Plants 6(1), 150–155.

Singh, N., Kushwaha, H.S., Singh, A., 2020. Integrated nutrient management on growth, yield, nutrient uptake and fertility balance in Soybean (*Glycine max* L.) – Wheat (*Triticum aestivum* L.) cropping sequence. International Journal of Bio-resource and Stress Management 11(1), 405–413.

Singh, S., Kumar, S., 2021. Medicinal plant sector in India: Status and sustainability. International Journal of Economic Plants 8(1), 081–085.

Srinivasan, V., Thankamani, C.K., Dinesh, R., Kandiannan, K., Hamza, S., Leela, N.K., Zachariah, T.J., 2019. Variations in soil properties, rhizome yield and quality as influenced by different nutrient management schedules in rainfed Ginger. Agricultural Research 8(2), 218–230.

Wei, C., Tsai, Y., Korinek, M., Hung, P., El-Shazly, M., Cheng, Y., Wu, Y., Hsieh, T., Chang, F., 2017. 6-Paradol and 6-shogaol, the pungent compounds of ginger, promote glucose utilization in adipocytes and myotubes, and 6-paradol reduces blood glucose in high-fat diet-fed mice. International Journal of Molecular Sciences 18, 168.

Yeh, H., Chuang, C., Chen, H., Wan, C., Chen, T., Lin, L., 2014. Bioactive components analysis of two various gingers (*Zingiber officinale* Ros.) and antioxidant effect of ginger extracts. LWT-Food Science and Technology 55, 329–334.