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Evaluation of farmer's cultivars of black pepper (*Piper nigrum* L.) in hill zone (Zone-9) of Karnataka under areca based cropping system

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Abstract

Evaluation of twenty five farmer's cultivar of black pepper for growth, yield and quality was done during 2018-2021 in Siddapur taluk of Uttara Kannada district, Karnataka. Among the cultivars evaluated, the cultivar Kudure Bala recorded the maximum fresh yield (13.00 kg/vine), dry yield (4.67 kg/vine), better black pepper recovery (35.72%), better bulk density (631.18 g/l) and low PDI. The essential oil content, oleoresin and piperine contents were recorded maximum in var. Panniyur-1. Incidence of *Phytophthora* foot rot was also nil (zero) in cultivars Kalyani, Kudure Bala, Magod Jaddi collection and Sigandini. In addition to this, the cv. Kudure Bala had dull yellowish coloured stripes on berries of the matured spike which is one of the unique identifying characters of the cultivar.

Keywords: Black pepper, farmer's cultivars, growth, yield, quality, Kudure Bala

Introduction

Black pepper (*Piper nigrum* L.) prevalently acknowledged as the king of spices is one of the most important spices in the world and one of the principal agricultural commodities of commerce and trade in India. It is a climbing perennial vine belonging to family Piperaceae got its origin from ever green forests of Western Ghats of India. Black pepper of commerce is the dried berry and is valued for the aroma which is contributed by the essential oil present in its berries and the powerful pungency is from the alkaloid that is piperine. Black pepper is an important ingredient in traditional medicine. This can be either grown as sole crop with dead or live standard or as mixed crop with arecanut, coconut, cocoa, coffee and tea.

Uttara Kannada region of Karnataka (Zone-9) which is majorly *Malnad* area is bestowed with good climatic condition so there are more local cultivars that are found in the field of farmers. But, continuous use of low yielding cultivars, non-availability of superior planting material, incidence of pests and diseases, due to biotic and abiotic stress, non-adoption of appropriate agronomic practices are some of the major factors that contributes for low productivity in case of black pepper. Indian pepper fetches a premium price in international market due to its preference and intrinsic quality (Thomas, 2010) [21]. There is meagre information on the availability of improved cultivars other than Panniyur-1 for the arecanut mixed system of cultivation in the *malnad* region. However, some of the superior cultivars believed to be the high yielder and tolerant to the disease, pest and drought situation are available in the farmers system of cultivation. Hence, the present study was undertaken to evaluate such selected cultivars and identify the suitable ones to the region.

Materials and Methods

The experiment was conducted during 2018-21 at farmer's field at Balekoppa, Siddapura taluq, Uttara Kannada (Dist.) which comes under hill zone of Karnataka (Zone-9) and placed at the altitude of 564 m above mean sea level. In this study, twenty five local cultivars were tested by randomized complete block design which is replicated thrice with var. Panniyur-1 as check. The cultivars were planted and trailed on arecanut palms as standard with the spacing of 2.7 x 2.7 m. The study included 25 cultivars viz., Arishina Murta, Balekoppa Okkalu, Balekoppa Tirupugare, Bilimalligesara, Dadiga, Heggara Dadiga, Jeerigemunda, Kalyani, Kanmurta, Karimalligesara, Karimenasu, Kudure Bala, Kudragutta (Round leaf), Kudragutta (Small leaf), Magod Jaddi collection, Malabar, Nucch Menasu, Sambar Dadiga, Shamemane collection, Sigandini, Nucch Menasu (S), Tattikai collection, Uddagare, Jhoom and Panniyur-1.

The study of three years has a record of attributes like, growth, yield as well as quality parameters. The growth parameters includes height of vine, canopy compactness, leaf length, leaf breadth, internodal length, stomatal density. Yield and yield contributing parameters includes number of spikes at 3m height, number of spikes per m² area, spike setting, spike length, number of berries per spike, individual spike weight, diameter of dry berries, volume of 1000-berries, fresh and dry weight of berries, black pepper recovery and white pepper recovery. The pooled data of three years is given here under. The quality parameters includes black and white pepper recovery, essential oil content, oleoresin content, piperine content as well as bulk density. Percent disease incidence for *Phytophthora* foot rot was recorded from 0-4 scale (where, 0: No disease / apparently healthy, 1: 1 to 25 percent affected leaves, 2: 25 to 50 percent affected leaves, 3: 51 to 75 percent affected leaves, 4: More than 75 percent affected leaves) given by Abraham *et al.* (1995) [1].

Results and Discussion

Growth parameters

Pooled analysis of three years data pertaining to growth revealed that there was a significant difference in most of the parameters recorded. The growth habit of 25 local cultivars illustrates that the maximum vine length was found in the cv. Bilimalligesara (14.73 m) which might be due to the inherent character of the vine to have vigorous growth in identical management conditions and the minimum length of vine was recorded in the cv. Balekoppa Okkalu (11.97 m) (Table 1). These results were in-line with the studies conducted by Hegde *et al.* (2017) [7], Hussain *et al.* (2017) [8], Tripathi *et al.* (2018) [22] and Pannaga (2021) [15]. The canopy compactness *i.e.*, number of laterals at 3m height was found highest in the cultivar Sigandini (79.78) which was on par with cvs. Kudure Bala (78.34), Karimalligesara and var. Panniyur-1 (76.22 each). This result was in accordance to the findings of Prasannakumari *et al.* (2001) [16], Maheswarappa *et al.* (2012) [12] and Pannaga (2021) [15].

The maximum leaf length was recorded in the cultivar Magod Jaddi collection (21.65 cm) followed by cv. Kudure Bala (20.15 cm) and lowest was in cv. Kudragutta (RL) (13.07 cm). Similarly, evaluated black pepper cultivars varied significantly among each other for leaf breadth. The maximum leaf breadth was obtained in the cultivar Magod Jaddi collection (14.54 cm) which was on par with cv. Kalyani (14.36 cm) while the minimum leaf breadth was found in Bilimalligesara (7.70 cm). The variations occurred in the leaf dimension may be owing to inherited character as well as environmental effect. Similar results were obtained by Sasikumar *et al.* (2004) [19] and Hussain *et al.* (2017) [8] in black pepper. The maximum internodal length was recorded in the cv. Kudure Bala (13.67 cm) which was on par with cv. Magod Jaddi collection (13.29 cm) meanwhile minimum internodal length was recorded in the cultivar Nucchu Menasu (8.51 cm). This was similar with the findings of Sasikumar *et al.* (1999) [18] and Vanaja *et al.* (2008) [23]. This might be due to the varietal character to produce vines with more internodal length. Stomatal density was found highest in the cv. Sambar Dadiga (54.20/mm²) and least in cv. Arishina Murta (22.58/mm²). The results were similar with the findings of Sulok *et al.* (2019) [20] in black pepper and Caine *et al.* (2019) [5]. These results may help the plant to get aquent to the drought condition because lesser the stomatal density, lesser

the evapotranspiration loss thus it helps in conservation of water molecule and helps to survive in drought condition.

Yield and yield contributing characters

The maximum number of spikes (240.56) at 3m height from the base was found in the cv. Kudure Bala while the minimum number was recorded in cv. Jeerigemunda (131.89) in the present study (Fig. 1). The maximum number of spikes per m² was recorded in cv. Sigandini (64.00) which was on par with cv. Kudure Bala and var. Panniyur-1 (63.11 each) (Table 2). Similar results were recorded by Prasannakumari *et al.* (2001) [16], Bhagavantagoudra *et al.* (2008) [4], Maheswarappa *et al.* (2012) [12] and Pannaga (2021) [15]. This was mainly due to cv. Sigandini, a vigorous type of plant produced more number of laterals with more fruiting branches. The greater number of spikes produced per unit area directly indicates that there will be a better source to sink ratio and thus the yield. A maximum spike length (16.33 cm) was obtained in var. Panniyur-1 followed by cv. Uddagare (15.04 cm) while the minimum was recorded in the cv. Tattikai collection (6.70 cm) (Table 2). The present result was in line with the studies of Hussain *et al.* (2017) [8] and Pannaga (2021) [15] in black pepper.

The spike weight is also an important character for selection of any of the cultivars in black pepper. Highest individual weight of spikes was recorded in the cv. Kudure Bala (16.10 g) which was at par with Uddagare (15.92 g), var. Panniyur-1 (15.69 g) and cv. Sigandini (15.32 g). While the lowest individual spike weight was recorded in cv. Kalyani (7.61 g) which was on par with cv. Heggara Dadiga (7.65 g) and cv. Jeerigemunda (7.77 g) in the evaluated cultivars. This outcome was in accordance with the studies of Jahagirdar and Siddaramaiah (2000) [10] in black pepper. The number of berries per spike has the important part in deciding the ultimate yield of the crop. It was found maximum in cv. Kudure Bala (105.80) which was on par with var. Panniyur-1 (105.00) and cv. Sigandini (104.52) and minimum number of berries was found in cv. Heggara Dadiga (41.63). This result was in accordance with the findings of Ravindran *et al.* (2000) [17], Prasannakumari *et al.* (2001) [16], Arya *et al.* (2003) [3] and Sasikumar *et al.* (2004) [19] in black pepper. The reasons for this might be due to the longer spikes in these cultivars and better setting of berries in the spikes. But in spite of being not too long, the spikes of cv. Kudure Bala found to have more number of berries which was due to the more number of bisexual flowers. It was also found that the seasonal variation have direct impact on berries per spike (Ibrahim *et al.*, 1985) [9]. The number bisexual flowers in a spike were more leading to more number of berries in a spike and the production of bisexual flowers in a spike is governed by genetic and environmental factors. The maximum diameter of dry berries was recorded in the cv. Sigandini (6.16 mm) and minimum was recorded in cv. Magod Jaddi collection (3.10 mm). Similarly, in one of the reports, the maximum diameter (0.7 cm) of black pepper berry was recorded (Anon., 2008) [2]. The volume of 1000-berries was found maximum for the cv. Kudure Bala (221.56 cc) which was on par with cv. Sigandini (216.22 cc) (Fig. 1). While the minimum was recorded in cv. Malabar (143.89 cc). The volume of berries may increase with increase in starch content, size and also time of harvest at the maturity stage. The yield parameters like fresh weight of berries per vine, dry weight of berries per vine, black pepper and white pepper recovery differed significantly among the cultivars. The higher berry yield is of

immense importance for the farmer's point of view. This study reveals that maximum fresh yield per plant was found in the cv. Kudure Bala (13.00 kg) that surpassed the check var. Panniyur-1 (12.34 kg). The parameters like number of hermaphrodite flowers, canopy compactness, number of spikes in 3m height, number of spikes per 100-leaves, individual spike weight, number of berries per spike, volume of 1000-berries were found to be maximum in cv. Kudure Bala. While, cv. Kalyani (5.26 kg) recorded least fresh yield among the cultivars. Similar reports were obtained from the studies of Hussain *et al.* (2017) [8], Pannaga (2021) [15]. Similarly, the maximum dry yield per plant was recorded in the cv. Kudure Bala (4.67 kg) followed by var. Panniyur-1 (4.28 kg). However, minimum dry yield was recorded in cv. Kalyani (1.65 kg). This might be mainly due to maximum fresh berry yield per vine and comparatively higher recovery of black pepper apart from other spike and berry characters. Tripathi *et al.* (2018) [22] and Arya *et al.* (2003) [3] stated that there will be yield difference between any cultivars or varieties due to various spike and berry characters.

The recovery of the black pepper has important role in determining the ultimate quality in black pepper. Every single cultivar will be having its own recovery rate that depends upon moisture and endosperm contents. In the present study, maximum recovery of black pepper was observed in cv. Sigandini (37.86%) followed by cvs. Kudure Bala (35.72%), Magod Jaddi collection (35.41%) and Dadiga (35.30%). This was due to higher dry matter accumulation in all the cultivars and also starch content in the berries. While the minimum recovery percentage of black pepper was recorded in cv. Nucchu Menasu (30.87%). The percent recovery may vary with different cultivars, presence of starch, moisture content and maturity of the berries. According to Prasannakumari *et al.* (2001) [16], Arya *et al.* (2003) [3], Mohan Kumar (2018) [13], Pannaga (2021) [15] recorded similar results in black pepper. The present study revealed that cv. Sigandini was having

maximum white pepper recovery (29.82%) which was on par with var. Panniyur-1 (29.33%). The lowest recovery was recorded in cv. Uddagare (20.78%). Hussain *et al.* (2017) [8], Mohan Kumar (2018) [13], Pannaga (2021) [15] reported similar outcome. The higher white pepper recovery was due to accumulation of more amount of starch content in the berries.

Quality parameters

The quality in black pepper berries is important and hence different quality characters were studied in 25 cultivars in Uttara Kannada region. There existed considerable amount of variation present among the local cultivars regarding quality parameters *viz.*, bulk density (g/l), essential oil content (%), oleoresin content (%) and piperine content (%).

The bulk density of dried berries is considered one of the important qualitative characters in black pepper. Highest bulk density was recorded in cv. Sigandini (631.87 g/l) which was on par with cv. Kudure Bala (631.18 g/l), while the least bulk density was recorded in the cv. Kalyani (532.23 g/l) (Table 3). The essential oil content was found highest in var. Panniyur-1 (2.77%) followed by cv. Shamemane collection (2.22%) and least was in cv. Kudragutta (SL) (0.89%). The variation in essential oil content was reported by many researchers like Daba *et al.* (2017) [6], Naik *et al.* (2013) [14], (Hussain *et al.*, 2017) [8], Mohan Kumar (2018) [13] and (Pannaga, 2021) [15]. This can be attributed to genetic nature of cultivar, agro climatic conditions where they are grown, variation in the maturity of berries. The highest oleoresin content was found in the var. Panniyur-1 (8.08%) and lowest was recorded in cv. Magod Jaddi collection (3.83%). This result was in line with the findings of Kurian *et al.* (2002) [11] in black pepper. The piperine content was found maximum in var. Panniyur-1 (5.10%) followed by cv. Sigandini (4.96%) and minimum was found in cv. Jhoom and cv. Kanmurta (1.91% each). The piperine content varies with cultivar, maturity at harvest and also environmental effects.

Table 1: Growth parameters of twenty five evaluated black pepper cultivars

Sl. No.	Name of the cultivar	Height of vine (m)	Canopy compactness at 3m height	Leaf length (cm)	Leaf breadth (cm)	Internodal length (cm)	Stomatal density (No./mm ²)	Number of bisexual flowers
1	Arishina Murta	13.03	55.11	14.96	9.46	11.78	22.58	87.60
2	Balekoppa Okkalu	11.97	54.11	16.19	10.31	10.18	30.46	92.57
3	Balekoppa Tirupugare	14.50	62.67	17.25	10.20	10.55	34.06	96.24
4	Bilimalligesara	14.73	59.89	13.41	7.70	9.93	32.06	95.76
5	Dadiga	13.76	48.67	13.31	9.57	9.72	37.74	95.65
6	Heggar Dadiga	13.96	49.78	19.66	12.21	9.66	35.36	85.68
7	Jeerigemunda	12.74	47.22	17.16	12.02	11.02	24.80	83.41
8	Jhoom	13.13	55.33	16.47	9.97	10.68	32.58	90.32
9	Kalyani	12.93	50.78	20.49	14.36	10.04	34.84	81.42
10	Kanmurta	12.80	60.44	16.07	10.01	10.56	29.56	92.25
11	Karimalligesara	13.19	76.22	15.78	10.63	10.50	23.33	92.47
12	Karimenasu	12.37	68.67	16.00	11.04	11.01	23.21	94.00
13	Kudure Bala	12.65	78.34	20.15	13.32	13.67	35.97	99.46
14	Kudragutta (RL)	12.43	59.22	13.07	10.37	11.37	28.01	96.74
15	Kudragutta (SL)	13.22	57.89	15.62	10.67	11.39	27.73	96.22
16	Magod Jaddi collection	14.08	46.44	21.65	14.54	13.29	36.42	85.95
17	Malabar	13.19	56.44	15.66	12.52	11.90	34.77	97.23
18	Nucchu Menasu	13.90	65.45	15.49	8.82	8.51	31.73	89.96
19	Sambar Dadiga	13.28	67.34	15.45	10.37	10.55	54.20	94.88
20	Shamemane collection	13.16	59.56	16.93	12.40	12.26	23.44	96.54
21	Sigandini	13.12	79.78	15.03	10.37	10.68	28.46	98.82
22	Nucchu Menasu (S)	13.97	54.67	15.73	9.95	9.95	30.97	88.51
23	Tattikai collection	13.31	60.33	13.72	8.85	10.56	26.07	86.39
24	Uddagare	14.24	68.44	16.39	10.67	11.25	33.60	89.49

25	Var. Panniyur-1	14.22	76.22	17.84	12.80	11.74	31.33	99.11
	Mean	13.36	60.76	16.38	10.93	10.91	31.33	92.27
	S.Em±	0.18	1.50	0.61	0.46	0.35	0.65	0.15
	C. D. at 5%	0.52	4.26	1.73	1.31	0.98	1.86	0.41
	CV (%)	2.39	4.27	6.42	7.29	5.50	3.62	0.27

Table 2: Yield parameters of different black pepper cultivars grown under hill zone of Karnataka

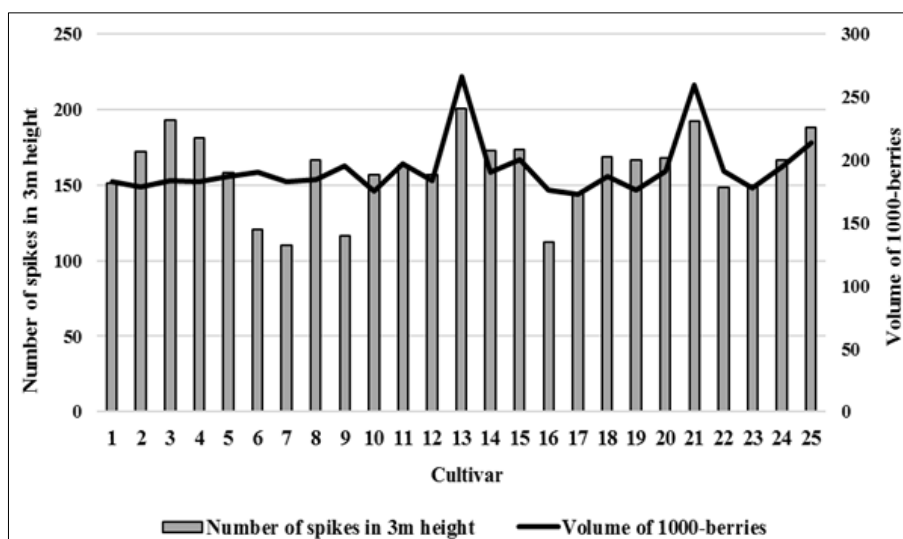
Sl. No.	Name of the cultivar	Number of spikes per m ²	Spike length (cm)	Spike weight (g)	Number of berries per spike	Diameter of dry berries (mm)	Fresh berry yield (kg/vine)	Dry berry yield (kg/vine)	Black pepper recovery (%)	White pepper recovery (%)
1	Arishina Murta	49.55	10.61	9.50	47.91	3.99	7.07	2.25	31.72	24.05
2	Balekoppa Okkalu	52.44	9.57	11.45	74.00	3.67	8.51	2.80	32.90	25.91
3	Balekoppa Tirupugare	60.78	11.6	11.41	77.00	3.50	9.50	3.29	34.70	27.19
4	Bilimalligesara	56.22	11.02	11.38	78.56	5.39	9.47	3.04	32.31	25.67
5	Dadiga	50.22	10.22	11.29	83.78	4.79	8.52	3.02	35.30	22.98
6	Heggar Dadiga	36.22	7.46	7.65	41.63	5.11	5.94	1.96	33.01	22.92
7	Jeerigemunda	33.89	7.27	7.77	48.12	3.74	5.73	1.84	32.01	23.49
8	Jhoom	51.00	11.22	11.61	82.21	3.41	8.33	2.63	31.64	21.93
9	Kalyani	40.22	9.11	7.61	50.62	4.84	5.26	1.65	31.21	22.76
10	Kanmurta	52.56	8.93	11.42	80.23	3.56	8.58	2.89	33.70	26.41
11	Karimalligesara	51.00	13.32	11.59	97.04	4.16	8.54	2.91	34.12	26.78
12	Karimenasu	50.45	7.99	10.35	79.22	4.54	8.45	2.95	35.03	23.18
13	Kudure Bala	63.11	13.75	16.10	105.80	5.69	13.00	4.67	35.72	28.02
14	Kudragutta (RL)	52.67	11.07	12.74	59.86	3.39	11.20	3.55	31.77	22.85
15	Kudragutta (SL)	54.78	10.97	13.27	60.90	3.60	10.39	3.36	32.35	23.40
16	Magod Jaddi collection	34.89	11.48	9.23	47.37	3.10	6.11	2.15	35.41	25.22
17	Malabar	46.00	11.21	13.46	76.68	3.24	11.28	3.70	32.70	22.86
18	Nucchu Menasu	54.89	9.46	11.18	76.97	3.24	8.47	2.62	30.87	20.98
19	Sambar Dadiga	51.11	9.79	11.60	83.40	3.24	8.63	2.99	34.77	24.37
20	Shamemane collection	52.22	7.40	11.36	70.08	5.17	10.00	3.37	33.54	21.44
21	Sigandini	64.00	14.06	15.32	104.52	6.16	10.67	4.04	37.86	29.82
22	Nucchu Menasu (S)	50.45	12.28	10.81	83.52	4.00	7.33	2.33	31.64	21.79
23	Tattikai collection	50.22	6.70	9.33	49.60	3.17	6.42	2.11	32.88	21.72
24	Uddagare	52.78	15.04	15.92	88.06	5.43	8.08	2.60	32.16	20.78
25	Var. Panniyur-1	63.11	16.33	15.69	105.00	5.03	12.34	4.28	34.90	29.33
	Mean	50.99	10.71	11.56	74.09	4.21	8.71	2.92	33.37	24.23
	S.Em±	0.81	0.22	0.36	1.44	0.09	0.09	0.04	0.41	0.26
	C. D. at 5%	2.31	0.63	1.03	4.11	0.25	0.25	0.11	1.17	0.75
	CV (%)	2.76	3.58	5.44	3.38	3.56	1.74	2.40	2.13	1.88

Percent disease incidence (PDI) for *Phytophthora* foot rot

Phytophthora foot rot disease is one of the devastating diseases that cause greater yield loss in the black pepper growing tract around the world. Apart from causing yield loss it also lowers the quality of black pepper. Among the cultivars evaluated, Balekoppa Tirupugare, Kanmurta, Karimenasu, Jhoom and var. Panniyur-1 recorded the intensity scale of 2 (25-50% affected leaves). The disease intensity of 1 (1 to 25% affected leaves) was recorded in the cultivars Arishina Murta, Balekoppa Okkalu, Bilimalligesara, Dadiga, Heggar Dadiga, Jeerigemunda, Karimalligesara, Kudragutta (RL), Kudragutta (SL), Malabar, Nucchu Menasu, Sambar Dadiga, Shamemane, Nucchu Menasu (S), Tattikai collection and Uddagare. There was no disease or apparently healthy leaves in various cultivars tested. Cultivars Kalyani, Kudure Bala,

Magod Jaddi collection and Sigandini recorded with no disease and the cultivars were found healthy with zero percent infestation. In spite of the heavy rainfall (2949 mm) in the study area also, the cvs. Kalyani, Kudure Bala, Magod Jaddi collection and Sigandini recorded no incidence of foot rot, which showed the immunity of the cv. to withstand foot rot in heavy rainfall condition. Here, the cv. Kalyani had minimum yield but was having the character to tolerate the foot rot disease. But in spite of having good yield in var. Panniyur-1 that is susceptible to the foot rot disease. This might be due the feeble plant immune and defence system against the pathogen and also pathogen load in the locations of the investigation.

Other than these qualities, each berry of cv. Kudure Bala had promiscuous yellowish stripes (variegated) on it.



Where,

- | | | | | | |
|---|----------------------|----|------------------------|----|----------------------|
| 1 | Arishina Murta | 10 | Kanmurta | 18 | Nucchu Menasu |
| 2 | Balekoppa Okkalu | 11 | Karimalligesara | 19 | Sambar Dadiga |
| 3 | Balekoppa Tirupugare | 12 | Karimenasu | 20 | Shamemane collection |
| 4 | Bilimalligesara | 13 | Kudure Bala | 21 | Sigandini |
| 5 | Dadiga | 14 | Kudragutta (RL) | 22 | Nucchu Menasu (S) |
| 6 | Heggar Dadiga | 15 | Kudragutta (SL) | 23 | Tattikai collection |
| 7 | Jeerigemunda | 16 | Magod Jaddi collection | 24 | Uddagare |
| 8 | Jhoom | 17 | Malabar | 25 | Var. Panniyur-1 |
| 9 | Kalyani | | | | |

Fig 1: Number of spikes in 3 m height and volume of 1000-berries in evaluated cultivars

Table 3: Quality parameters of twenty five evaluated black pepper cultivars and PDI for foot rot disease

Sl. No.	Name of the cultivar	Bulk density (g/l)	Essential oil (%)	Oleoresin content (%)	Piperine content (%)	PDI for foot rot
1	Arishina Murta	535.89	1.19	4.60	2.61	1
2	Balekoppa Okkalu	588.28	1.18	4.21	2.53	1
3	Balekoppa Tirupugare	586.20	1.34	5.78	2.06	2
4	Bilimalligesara	591.76	1.55	4.45	1.95	1
5	Dadiga	574.23	1.93	5.43	2.47	1
6	Heggar Dadiga	547.38	1.57	5.25	2.73	1
7	Jeerigemunda	540.99	2.19	6.80	3.88	1
8	Jhoom	588.43	0.93	4.50	1.91	2
9	Kalyani	532.23	1.28	4.31	2.77	0
10	Kanmurta	585.22	1.15	4.92	1.91	2
11	Karimalligesara	582.80	1.85	5.76	3.41	1
12	Karimenasu	578.12	1.25	5.42	2.92	2
13	Kudure Bala	631.18	1.50	5.86	4.33	0
14	Kudragutta (RL)	557.10	1.72	4.71	2.48	1
15	Kudragutta (SL)	575.31	0.89	4.00	2.27	1
16	Magod Jaddi collection	543.73	0.97	3.83	2.15	0
17	Malabar	583.47	1.17	4.56	2.55	1
18	Nucchu Menasu	578.23	1.58	6.43	4.27	1
19	Sambar Dadiga	584.24	1.51	4.82	3.23	1
20	Shamemane collection	593.17	2.22	4.78	2.90	1
21	Sigandini	631.87	1.97	7.56	4.96	0
22	Nucchu Menasu (S)	544.23	1.62	4.57	3.51	1
23	Tattikai collection	542.84	1.40	5.19	2.79	1
24	Uddagare	583.59	1.50	4.58	3.00	1
25	Var. Panniyur-1	546.50	2.77	8.08	5.10	2
	Mean	573.08	1.53	5.22	2.99	-
	S.Em±	2.17	0.02	0.04	0.04	--
	C. D. at 5%	6.18	0.06	0.11	0.13	-
	CV (%)	0.66	2.22	1.29	2.55	-

Where,

- 0 : No disease / apparently healthy
- 1 : 1 to 25 percent affected leaves
- 2 : 25 to 50 percent affected leaves
- 3 : 51 to 75 percent affected leaves
- 4 : More than 75 percent affected leaves

Conclusion

Among 25 cultivars evaluated, the cv. Kudure Bala recorded the maximum number of spikes at 3m height (240.56 no.s), maximum weight of the spike (16.10 g), maximum number of berries per spike (105.80), maximum volume of 1000-berries (221.56 cc), maximum fresh and dry yields of berries per vine (13.00 kg and 4.67 kg, respectively) were recorded in this cultivar. The bulk density of 631.18 g per litre was recorded in cv. Kudure Bala which was at par with cv. Sigandini (631.87 g/l). In spite of the more rainfall in the area of study (mean rainfall of 2949 mm), the cv. Kudure Bala had no sign of *Phytophthora* foot rot disease with PDI value of 0 (zero) which showed its stability to withstand in heavy rainfall area. Thus, the cv. Kudure Bala with unique identification character having yellowish stripes on its fresh berries can be used to get higher yield and quality berries for hill zone of Karnataka.

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