

Morphological Characterization and Evaluation of Local Black Pepper (*Piper nigrum* L.) Genotypes for Yield and Quality under Arecanut Based Cropping System

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Abstract

Twenty two black pepper genotypes were characterized morphologically and evaluated for growth yield and quality parameters under arecanut based cropping system during 2015-16 in Uttara Kannada (Dist.), Karnataka. Among them, var. Panniyur-1(control), SV-18 and SV-21 showed light green shoot tip colour, whereas,SV-6, 16, 17 had dark purple while, others had light purple colour. The maximum spike length (20.60cm) was recorded in var. Panniyur-1 followed by SV-12 and SV-20 (17.30cm each). The var. Panniyur-1 showed significantly highest fresh spike yield (24.23kg/vine), fresh berry yield (22.84kg/vine) and dry berry yield (8.22kg/vine).However, yield components viz., number of spikes per unit area, number of spikes per 100 leaves, individual spike weight differed statistically. Among the quality attributes, the bulk density was recorded at a maximum (650g/l) in the genotype SV-15 followed by SV-14 (627.67g/l). The essential oil content was found highest in var. Panniyur-1, SV-7, 2 and SV-16 (2.80% each).Whereas oleoresin was maximum (10.74%) in SV-7. However, the highest piperine content (5.50%) was recorded in genotype SV-15 and next best in SV-7 (5.49%).

Keywords: Genotypes; Evaluation; Spikes; *Piper nigrum* L.

Introduction

Black pepper (*Piper nigrum* L.), (Family- Piperaceae) christened as the 'King of Spices' and 'Black Gold' is an important commodity of commerce since time immemorial. It is one of the oldest and most important spices known to mankind. Black pepper of commerce is the matured dried berry and is valued for its aroma due to the essential oil, present in the berries and the pungency is due to its alkaloid piperine. It is mainly used as culinary item in processing food industries, perfumery, allied

industries and in traditional medicines. Black pepper is also very important in traditional medicine [1]. It is a climbing herbaceous perennial vine, native to humid tropical evergreen forests of Western Ghats of India. Black pepper is either grown as pure crop and largely as a mixed crop with arecanut, coffee and tea. Other tree species like Silver oak and *Erythrina indica* are also used as live standards in hill zone of Karnataka. The performance of black pepper varieties vary significantly

between plains and higher altitudes owing to difference in environmental conditions in addition to genetic differences [2]. Indian pepper fetches a premium price in major international markets because of its intrinsic quality [3]. But the continuous use of low yielding cultivars, non availability of planting materials, losses due to severe incidence of biotic and abiotic stress and non adoption of appropriate agronomic practices are some of the prominent factors contributing to low productivity of black pepper in India. There is no information on the availability of improved genotypes other than var. Panniyur-1 and local cultivars like Karimalligesara, Bilimalligesara, Uddakare, Doddiga for the arecanut mixed system of cultivation in Karnataka. However, some high yielding superior genotypes superior in quality and tolerant to drought situation, pest and diseases, that may available in the farmers fields. Hence, the present study was undertaken on morphological characterization and evaluation of local black pepper genotypes for growth, yield and quality under arecanut based cropping system.

Material and Methods

The experiment was conducted during 2015-16 at Chavatti, Hosmane, Yellapur Tq. Uttara Kannada (Dist.), Hill Zone of Karnataka (Zone-9) situated at an altitude of 590 m above MSL. This zone receives an annual average rainfall of 1687.48 mm, the mean maximum temperature was 37.11°C during April and mean minimum temperature was 18.41°C during January and the relative humidity ranged from 47.98 to 90.40 per cent. Twenty two genotypes were evaluated in Randomized Complete Block Design with three replications and treatments include the SV-2 to 22 genotypes and the var. Panniyur-1

as control. Genotypes were planted and trained on arecanut plant as a standard with a spacing of 2.7 x 2.7m and the vines are about 15 years age. Observations were recorded on morphological, growth, yield and quality attributes.

Results and Discussion

Among the growth parameters, var.Panniyur-1, genotypes SV-3, 17, 19 and SV-20 had hanging type of lateral branching pattern while, semi erect types were observed in SV-4, 8, 10, 13, 15, 16 and SV-21 and the remaining genotypes had horizontal type of branches. More number of stomata per unit area were seen in SV-2 (12.87) which was on par with SV-10 (12.83) and SV-13 (12.23) while, minimum was in SV-8 and SV-16 (9.50 and 9.53, respectively). The plant height was recorded maximum in SV-8 (9.40m). The variation in vine height is due to genetic nature of the cultivars when grown under identical conditions [4] in black pepper. Significantly maximum mean number of branches per m sq. area at 10 ft height was recorded in SV-12 (93.33) which was on par with var.Panniyur-1, SV-19 and SV-20, (91.67, 87.67 and 76, respectively). Maximum leaf length was observed in SV-19 (20.62cm) while the minimum was in SV-5 (15.26cm). The maximum leaf breadth (cm) was noticed in SV-7 (13.73cm) and lowest was recorded in SV-5 (7.62cm).The genotype SV-21 recorded highest chlorophyll content of (2.49 mg/g) which was statistically on par with SV-22 (2.19mg/g) whereas least was recorded in SV-2 (0.36 mg/g).Significantly longer spikes were recorded in var.Panniyur-1 (20.60cm) followed by SV-12 and SV-20 (17.30cm each, respectively) while it was minimum in SV-21 (9.67cm) (Table 1).

Genotype	Vine height (m)	No. of branches/m ² area at 10 ft ht.	Lateral branching pattern	Leaf length (cm)	Leaf breadth (cm)	Petiole length (cm)	Stomatal density in leaf (No./cm ²)	Leaf chlorophyll (mg/g)
Panniyur-1	9.13	91.67	Hanging	16.59	13.25	2.57	10.8	1.01
SV-2	8.88	46.67	Horizontal	17.24	11.18	2.15	12.87	0.36
SV-3	9.2	65.67	Hanging	17	8.01	2.93	12.03	0.98
SV-4	9.2	39.33	Semi-erect	17.43	12.37	2.66	10.7	0.8
SV-5	6.73	34	Horizontal	15.26	7.62	2.03	10.27	0.96
SV-6	6	37.67	Horizontal	17.12	11.31	2.03	10.57	0.81
SV-7	7.97	50	Horizontal	18.8	13.73	2.82	10.73	1.06
SV-8	9.4	60	Semi-erect	19.05	12.17	2.66	9.5	0.96

SV-9	8.13	30.67	Horizontal	18.97	12.62	2.07	10.07	0.72
SV-10	7.57	56	Semi-erect	19.47	12.21	2.16	12.83	0.98
SV-11	8.33	60	Horizontal	18.63	11.49	2.49	11.48	1.19
SV-12	7.37	93.33	Horizontal	17.47	11.87	1.85	10.63	0.93
SV-13	8.07	49.67	Semi-erect	15.76	8.78	2.03	12.23	0.99
SV-14	8.17	64.33	Horizontal	17.33	12.42	2.39	10	0.91
SV-15	3.67	64.67	Semi-erect	15.45	8.4	1.49	10.1	0.62
SV-16	8.5	32	Semi-erect	18.4	12.2	2.45	9.53	0.43
SV-17	8.67	67.33	Hanging	18.57	12.18	2.82	10.33	1
SV-18	8.73	43.33	Horizontal	17.42	8.91	2.51	12.15	1.26
SV-19	9.03	87.67	Hanging	20.62	12.27	2	10.45	1.27
SV-20	8.53	76	Hanging	20.32	13.49	2.73	11.93	1.31
SV-21	9.37	52	Semi-erect	20	11.11	2.97	10.56	2.49
SV-22	8.23	52.67	Horizontal	18.5	11.72	2.14	10.5	2.19
Grand mean	8.13	57.03		17.97	11.33	2.36	10.92	1.06
S. Em±	0.4	6.27		0.79	0.82	0.06	0.23	0.11
CD (5%)	1.13	17.89		2.27	2.33	0.17	0.65	0.32
CV (%)	8.42	19.03		7.66	12.5	4.3	3.64	18.47

Table 1: Vine height, branching and leaf characters in different genotypes of black pepper (*Piper nigrum* L.).

Among the evaluated genotypes for morphological traits, the genotype SV-18 and SV-21 showed light green shoot tip colour similar to var. Panniyur-1, whereas, SV-6, 16, 17 showed dark purple shoot tip while, other genotypes had light purple shoot tip. The genotypes SV-12 and var. Panniyur-1 showed chordate type of leaf shape whereas, the genotypes SV-5, SV-10, SV-11, SV-13, SV-14, SV-15, SV-16, SV-18, SV-19 and SV-21 were having acute type, while the others were of round types. The genotypes SV-4, SV-6, SV-7, SV-16, SV-17 observed to be ovate-elliptic type of leaf lamina shape and chordate type was noticed in var. Panniyur-1, SV-5, SV-9, SV-11, SV-12 and others were ovate lanceolate type. The wavy type of leaf margin was seen in genotypes SV-14, SV-15, and SV-18 and the remaining genotypes recorded even type of leaf margin. Acrodromous type of leaf venation were observed in the genotype SV-2 while, eucamptodermous type was observed in SV-6 and SV-21 and the remaining genotypes were showing campylodromous type of leaf venation. In case of leaf texture genotypes SV-4, SV-8, SV-7, SV-8, SV-11, SV-13, SV-14, SV-15, SV-17 and SV-18 were of rough leaf texture, whereas, the remaining genotypes were having smooth leaf texture. In terms spike attributes, twisting type of spikes were noticed in genotypes SV-2, SV-11 and SV-21, whereas, it was absent in other the genotypes. Cylindrical type of spike shape was seen in the

SV-13 and SV-14, whereas, the remaining genotypes had filiform spike shape. Loose setting of berries in a spike were noticed in the genotype SV-2, 3, 5 and SV-8 and compact setting was found in SV-4, 13, 15, 16 and SV-18 while the other genotypes were having medium loose settings. The arrangement of berries on the spike as very compact because of high productive bisexual flowers (98%) with a high setting percentage (91.5% and the berries are compactly arranged on the spike [5].

In terms of yield and yield attributing characters, the number of spikes per 100 leaves at 2m was found to be maximum in SV-11 (70.33) followed by SV-12 (58.33) and SV-6 (58). The mean number of spikes per column at different heights up to 3m was recorded. At one meter height the mean no. of spikes was found to be highest in SV-17 (187.66) followed by SV-4 (156) and it was lowest in SV-16 (56.26). Similarly, at 2m height the genotype SV-11 shown maximum spikes (263.67), which was on par with SV-17 (256.55) and SV-20 (256.46) while, it was lowest in SV-16 (84.70) and at 3m height SV-14 recorded maximum number of spikes (321.40), it was statistically on par with SV-20 (308.33) whereas, lowest spikes were noticed in SV-13 (105). [6] observed, Panniyur-5 having significantly higher number of spikes (238 in one meter column height) which was on par with IISR The vam

(202.5) and OPKM (186.6) while, lowest was in HP-780 (21.5). The upper part of the canopy with a relatively high leaf area during the spike development period and higher photosynthetic rate promote the development of productive laterals and sustains relatively large number of spikes [7]. The fresh spike yield per vine was maximum in var.Panniyur-1 (24.23kg) and lowest was recorded in SV-15 (1.27kg). Significantly highest fresh weight of berries per vine was recorded in var.Panniyur-1 (22.84kg/vine) followed by SV-7 (16.89kg/vine) whereas,

lowest was obtained in SV-15 (0.444kg/vine) [8] reported spike yield and spike number in black pepper as important traits contributing for yield. The quantitative traits, green berry yield per vine, spike number, spike length are known to influence the yield of black pepper [9]. Different varieties perform based on its genotypic character and its exposure to environment, distribution of pre-monsoon showers, incidence of anthracnose disease and spike shedding [10] (Table 2).

Genotype	Fresh wt. of spike/ vine(kg)	Fresh wt. of berries / vine(kg)	Dry yield of berries/vine (kg)	Black pepper recovery (%)	White pepper recovery (%)	Bulk density (g/l)
Panniyur-1	24.23	22.84	8.22	36	31.04	528.67
SV-2	18	15.33	5.59	36.49	17.37	618
SV-3	11	8.63	3.2	37.11	27.05	555.33
SV-4	12	10.07	3.42	34.21	19.25	547.67
SV-5	7.92	5.45	1.8	33.08	15.67	480.33
SV-6	7.59	6.06	2.21	34.32	28.25	616.33
SV-7	20.27	16.89	5.29	31.3	21.1	574
SV-8	5.99	3.71	1.37	37	20.84	521.67
SV-9	11.99	10.46	3.66	34.99	14.19	560.67
SV-10	12.85	10.48	3.94	37.57	27	622.67
SV-11	15.44	13.06	4.78	36.57	29.14	585.33
SV-12	11.14	8.78	3.32	37.82	25.12	616.33
SV-13	8.12	8.27	2.61	31.59	27.94	601.67
SV-14	11.01	9.61	3.81	38.52	17.25	627.67
SV-15	1.27	0.44	0.17	38.27	27.25	650.33
SV-16	3	2.75	0.99	35.99	31	520.33
SV-17	18.34	14.84	4.73	31.88	29.25	550
SV-18	12.82	10.84	3.81	35.17	18.32	551.67
SV-19	10.73	8.67	3.31	38.17	28.7	600.67
SV-20	17.7	14.59	4.18	28.65	18.17	601.67
SV-21	9.79	8.01	3.17	39.61	30.33	589.67
SV-22	10.34	9.12	3.3	36.17	30.25	534.67
Grand mean	11.89	0.27	3.54	35.85	24.29	575.24
S. Em±	0.23	0.77	0.13	0.85	0.28	5.7
CD (5%)	0.64	4.59	0.36	2.44	0.81	16.27
CV (%)	3.28	10.13	6.14	4.13	2.01	1.72

Table 2: Yield characters in different genotypes of black pepper (*Piper nigrum* L.).

Similarly, in the present study higher yield in var. Panniyur-1 was due to longer (20.60 cm) and heavier spikes (17.92 g/spike) with more number of berries per spike (91.33) and in SV-7 higher spike weight, more number of berries per spike, bigger size of dry berries resulted in higher yield. However, the fresh weight of berries per vine was recorded significantly highest in var. Panniyur-1 (22.84 kg/vine) followed by SV-7 (16.89 kg/vine) and lowest was in SV-15 (0.444 kg/vine). The variation in fresh berry weight was recorded in black pepper cultivars studied by Bhagavantagoudra et al. (2008) [10,11] as the performance of five varieties of under coffee based cropping system on *Erythrina indica* as the standard. Among the varieties tested, the cumulative yield of green pepper was found highest in var. Panniyur-3 (19.06 kg/vine) followed by var. Panniyur-5 whereas, lowest was in Karimunda (8.63 kg/vine). Hence, the contributing characters like increased number of spikes, length of spike, number of berries per spike, etc. have direct effect on fresh berry yield in black pepper. The genotype SV-13 recorded significantly maximum individual spike weight of (22.33 g) followed by var. Panniyur-1 (17.92 g), SV-16 (17.25 g) and SV-6 (17.17 g) while the lowest was found in SV-8 (7.90 g).

Among the quality parameters, the maximum essential oil content (2.80%) were recorded in the genotypes (var. Panniyur-1, SV-7, 2, and SV-16) while it was lowest (1.60%) in the genotypes (SV-6, 8, 11 and SV-19). This can be attributed to the effect of cultivar, agro climatic conditions, differences in the maturity of spikes and method of oil extraction [12,13]. The oleoresin content were obtained maximum in genotype SV-7 (10.74%) followed by SV-4 (9.39%) and SV-21 (9.31%), while lowest was in genotype SV-9 (4.27%). The maximum piperine content was recorded in the genotype SV-15 (5.50%). The genotype SV-15 recorded highest bulk density of (650 g /l) followed by SV-14 (627.67 g /l) and lowest was found in SV-5 (480.33 g/l). For export purpose, the minimum bulk density should be (>500 g/l). Bulk density is the major physical property of biomass and it influences directly the cost of the substances [14]. In the present study out of 22 evaluated genotypes, nine genotypes (SV-2, 6, 10, 12, 13, 14, 15, 19 and SV-20) had more than 600g per liter bulk density, whereas thirteen genotypes (var. Panniyur-1, SV-3, 4, 5, 7, 8, 11, 16, 17, 18, 21 and SV-22) recorded more than 500g per liter only the genotype SV-5 showed lower bulk density (480.33 g/l). Hence, the local genotypes available at the farmers field are having potential to perform for better yield with higher quality characters.

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