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Evaluation of Local Black Pepper (*Piper nigrum* L.) Genotypes for Growth and Morphological Characters in Uttara Kannada District of Karnataka (Zone-9)

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ABSTRACT

Twenty two black pepper genotypes were evaluated for growth and morphological characters based on shoot tip colour, leaf and spike nature under arecanut based mixed cropping system during 2015-16 in Uttara Kannada (Dist.), Karnataka. Among the genotypes maximum vine height was recorded in the genotype SV-8 (9.40m). The mean number of branches per sq.m area at 10 ft height were recorded highest in the genotype SV-12 (93.33Nos.) and spike length (20.60cm) was recorded in var. Panniyur-1 followed by SV-12 and SV-20 (17.30cm each). The leaf length was observed highest in genotype SV-19 (20.62cm) while broader leaves in SV-7 (13.73cm) and maximum petiole length (2.97cm) in genotype SV-21. The genotype SV-21 showed highest chlorophyll content of (2.49mg/g). The higher number of stomata per unit area of leaf was seen in genotype SV-2 (12.87) and minimum in SV-8 (9.50). The var. Panniyur-1, SV-18 and SV-21 showed light green shoot tip colour, whereas, SV-6, 16, 17 had dark purple while, others were having light purple. The var. Panniyur-1, genotype 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 whereas, the remaining genotypes had horizontal type of branches. The morphological characters of leaf were observed viz., leaf venation, leaf shape, lamina shape, leaf margin, leaf texture were varied among the genotypes similar kind of variation were recorded in spike characters like, spike twisting, spike shape and spike setting.

Key words: *Genotypes, Morphology, Piper nigrum L.*

INTRODUCTION

Black pepper (*Piper nigrum* L.) is one of the most important spices of the agricultural commodities of commerce and trade in India since pre historic period. Among the spices, black pepper occupies a unique position and hence, called as the 'King of spices' and widely used for food flavoring.

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It is climbing herbaceous perennial vine belonging to the family Piperaceae and native to humid tropical ever green forests of Western Ghats of India.Black pepper of commerce is the matured dried berry and is valued for its aroma contributed by the essential oil, present in the berries and the pungency 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 being largely grown in India, Indonesia, Malaysia, Brazil, Thailand, Sri Lanka, Vietnam and China. India is the major producer of black pepper with an area of 1.28 lakh hectares and production of 64,000 tonnes with a productivity of 502 kg per hectare. The total area and production of spices in the country is 33.17 lakh ha and 61.08 metric tonnes, respectively. The productivity of different black pepper producing countries is Indonesia (622 kg/ha), Malaysia (1500 kg/ha), Brazil (2075 kg/ha), Thailand (1375 kg/ha), Sri Lanka (849 kg/ha), Vietnam (2301 kg/ha) and China (1160 kg/ha)[3]In India, it is largely grown in Kerala and Karnataka, the rest being in Tamil Nadu, Andhra Pradesh and Northeastern states mainly, Assam. Among these Kerala occupies maximum area of 85,000 hectares with total production of 40,000 tonnes with the productivity of 476 kg per ha, whereas in Karnataka black pepper is cultivated in an area of 32,000 hectare with production of 19,000 tonnes and with a productivity of 602 kg/ha, mainly grown in Chickmagalur, Shivamogga, Uttar Kannada and Dakshina Kannada districts[3].Black pepper is either grown as pure crop and largely as a mixed crop with arecanut, coffee and tea. Silver oak and *Erythrina indica* are also used as live standards in hill zone of Karnataka. The performance of black pepper varieties varies significantly in plains and higher altitudes owing to differences in environmental conditions in addition to genetic sources[5]. The diversity of black pepper is great in evergreen forests of Western Ghats due to the process of natural evolution and domestication. The cultivar diversity is high therefore breeders have good scope for selection of the parents for crop improvement. Cultivar diversity is one of the principal components of diversity in black pepper. There exists considerable variation for yield among cultivars[8].The genotypic diversity is maximum in Kerala followed by Karnataka. In Kerala mainly grown cultivars are Karimunda, Neelamundi, Kaniyakadan, Narayankodi, Perumkodi and variety Panniyur-1, whereas, in Karnataka, local cultivars which are found in farmers field are Karimalligesara, Bilimalligesara, Uddakare, Doddiga and var. Panniyur-1. The higher productivity can be obtained by mono-cropping and better agronomic practices[1]. continuous use of low yielding cultivars, non availability of superior planting materials, losses due to diseases, pests, droughts, non adoption of appropriate agronomic practices are some of the prominent factors contributing to low productivity of black pepper in India. However, some of the superior cultivars believed to be the high yielders and tolerant to diseases, pests, and drought situation and are available in the farmers field. Hence there is a need to identify the local genotypes based on growth and morphological characters for the crop improvement.

MATERIAL AND METHODS

The experiment was initiated during 2015-16 at Chavatti, Hosmane, Yellapur Tq. Uttara Kannada (Dist.), Hill Zone of Karnataka (Zone-9) situated at an altidude of 590 m above MSL. This Zone receives an annual average rainfall of 1687.48 mm, the mean maximum temperature was 37.11°C (April) and mean minimum temperature was 18.41°C (January) and the relative humidity ranged from 47.98 to 90.40 per cent. The 22 genotypes were tested by following Randomized Complete Block Design with three replications and treatments includes SV-2 to 22 genotypes and 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. Observations were recorded on morphological traits, growth characteristics of black pepper as per the descriptors of black

pepper IPGRI (Rome) and guidelines of DUS test (1995).

Growth attributes

The vine height was measured from the ground level to tip of the vine by using range finder (Hypsometer, nickon make) and expressed in metre. The number of branches was counted in the 1sq.m area of vine at 10ft height from ground level. The lateral branching pattern was recorded based on visual assessment of the appearance of plagiotropic branches**.** There are three types of lateral branching pattern were present i.e. semi erect, horizontal and hanging type. The spike length was measured from base of the pedicel to tip of the spike, by selecting ten random spikes and mean values were expressed in centimetres. The leaf length was measured from the base of midrib to the tip. It was taken as an average of ten randomly selected matured leaves of plagiotropic branches of each vine and mean values were expressed in centimeters. The leaf breadth was measured at

Acute - Margin straight to convex forming a terminal angle 45^0 to 90^0.

Cordate - Lobes rounded sinus depth 1/8 to ¼ distances to midrib point of the blade.

Round - Margins forming a smooth arc.

The lamina shape was assessed from the fourth matured leaf with spike of plagiotropic branches. The lamina shapes like ovate, ovate-lanceolate, ovate-elliptic and cordate.

Ovate - With the widest axis below middle and with margins symmetrically curve egg shaped.

Cordate - Heart-shaped, with a sinus and surrounded lobes at the base and ovate in general outline.

Ovate-elliptic - Ovate in shape, but the widest axis at the midpoint.

Ovate- lanceolate - Much longer than the broad, widening above the base and tapering to the apex.

The leaf margin was assessed from the matured leaves of plagiotropic branches of the middle of the vine. There are two types of leaf margin were observed i.e. even and wavy.

Even - Leaves without indentations or incisions on margins; smooth.

the maximum width, from ten randomly selected matured leaves of plagiotropic branches of each vine and mean values were expressed in centimetres. The leaf petiole length was measured from the base to the insertion with the leaf lamina, on an average from the randomly selected ten matured leaves of plagiotropic branches. The values were expressed in centimeter. The stomatal density was recorded by counting the number of stomata per field of 1cm sq. area of medium matured leaf of the plagiotropic branches under binocular microscope.

Morphological parameters of shoot tip colour, leaf structure and spike shapes

The shoot tip colour was recorded based on visual assessment of the runner shoots. The type of colour on the shoot tip were recorded like light green, light purple and dark purple.The leaf shape was assessed from the fourth matured leaf of plagiotropic branches. There are three types of leaf base shapes were present i.e. round, cordate and acute.

Wavy - Slightly folded or with insertion.

The leaf venation was assessed from the matured leaves of plagiotropic branches of the vine and the types of leaf venations were observed like acrodomous, eucamptodermous and campylodromous.

The leaf texture was assessed from the matured leaves of plagiotropic branches of the vine and the texture noticed like smooth and rough.

The spike twisting and spike shape was recorded based on visual assessment of spikes of the entire vine. There was four types of spike shapes were present i.e. filiform, cylindrical, globular and conical. The spike setting was recorded based on visual assessment of the extent of compactness of the berries in the spike i.e. loose, medium loose and compact.

RESULTS AND DISCUSSION

Growth attributes

The growth parameters like vine height, number of branches per sq. m area at 10ft height, leaf length, leaf breadth, petiole length and leaf chlorophyll content was recorded. The

significantly maximum vine height was recorded in the genotype SV-8 (9.40m). The genotype SV-8 was on par with SV-21, 3, 4, 20, 16 and SV-11, whereas, it was the lowest in genotype SV-15 (3.67m). The variation in vine height is due to genetic nature of the cultivars when grown under identical conditions[9]. The mean number of branches per sq.m area at 10 ft height recorded maximum in the genotype SV-12 (93.33nos.) which was on par with var. Panniyur-1, SV-19 and SV-20, while lowest value was observed in genotype SV-9 (30.67nos.). The variation in lateral branches in varieties tested, the variety IISR Thevam had significantly higher number of laterals (58nos. in one m column) followed by Sreekara (40) and Panchami (40). Hybrid HP-34 (16), Panniyur-2 (20.6) and Panniyur-3 (22.8) recorded significantly lower number of branches[6]. The significantly superior spike length was noticed in var. Panniyur-1 (20.60cm) and next best by genotype SV-12 and SV-20 (17.30cm each), whereas, lowest in SV-21 (9.67cm). Among the evaluated genotypes the maximum leaf length was observed in SV-19 (20.62cm) and it was on par with SV-7, 8, 9, 10, 11, 16, 17, 20, 21 and SV-22, while the minimum leaf length was seen in SV-5 (15.26cm). The data revealed that, broader leaves were noticed in genotype SV-7 (13.73cm), which was on par with Panniyur-1, SV-4, 8, 9, 10, 11, 2, 14, 16, 17, 19, 20 and SV-22, whereas, narrower leaves were recorded in genotype SV-5 (7.62cm). The maximum petiole length was found in genotype SV-21 (2.97cm) and it was on par with SV-3, SV-7 and SV-17, whereas, lowest in SV-15 (1.49cm). The variation in the leaf dimension was due to genetic and environmental effect. The higher number of stomata per unit area of leaf was seen in genotype SV-2 (12.87) which was on par with SV-10 and SV-13, while, minimum in SV-8 (9.50). If the number of stomata per unit area were less, rate of transpiration also be less and the water requirement of the genotype reduces, so the genotype can be considered as drought resistance. Therefore genotype SV-8 could possibly be a source for development of drought resistant variety.

The genotype SV-21 recorded highest chlorophyll content of (2.49mg/g) which was on par with SV-22 (2.19mg/g) while, it was minimum in SV-2 (0.36mg/g).

Morphological characters

Among the morphological parameters recorded. The genotypes are distinguished basically by observing the shoot tip colour in black pepper. The genotype SV-18 and SV-21 showed light green shoot tip colour similar to var. Panniyur-1, whereas, dark purple shoot tip genotypes was observed in SV-6, 16, 17 and SV-20, while, other genotypes were noticed light purple shoot tip colour. There are three types of branching pattern were recorded. The var. Panniyur-1, genotype 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.

The three different types of leaf venations were recorded in the evaluated black pepper genotypes. Among them, The acrodomous type of leaf venation was found only in the genotype SV-2, while the genotype SV-6 and SV-21 shown eucamptodermous leaf venation and the others were campylodromous types similar to var. Panniyur-1. The cordate type of leaf base shape was noticed in the var.Panniyur-1 and genotype SV-12, whereas, the genotypes SV-5, 10, 11, 13, 14, 15, 16, 18, 19 and 21 shown acute type of leaf base shape, while the others SV-2, 3, 4, 6, 7, 8, 9, 17, 20 and 22 were round type leaves. The round shaped leaves in IISR Thevam and IISR Girimunda while IISR Malabar Excel had acute shaped leaves[9]. The ovate-elliptic type of leaf lamina shape was noticed in the genotype SV-4, 6, 7, 16, and 17, whereas, SV-1, 5, 9, 11 and 12 having cordate type similar to Panniyur-1. While, the other genotypes were having ovate lanceolate type of leaf lamina. The improved vars. like IISR Thevam and IISR Girimunda had ovate elliptic type of leaves, whereas, IISR Malabar Excel had elliptic lanceolate leaves[9]. The wavy type of leaf margin was seen in genotype SV-14, SV-15 and SV-18 and the other genotypes were

having even type of leaf margin. The variation in leaf type and leaf margin is due to genetic character of the crop in black pepper that helps in distinguishing the variety. The genotypes SV-4, 8, 7, 8, 11, 13, 14, 15, 17 and SV-18 were recorded rough leaf texture, whereas, the remaining genotypes were having smooth leaf texture similar to Panniyur-1.

Among the morphological parameters recorded on spike namely, spike twisting, spike shape, spike setting. The twisting type of spike was found in genotypes SV-2, 11 and SV-21 while, it was absent in var. Panniyur-1 and other genotypes. Ravindran[8] classified the South Indian *Piper* genus under two major sections *viz.*, 'Pippali' and 'Maricha'. The major diagnostic character between them is the orientation of spikes, erect in 'Pippali' and pendent in 'Maricha'. The twisting of spike is genotypic character. The cylindrical type of spike shape was observed only in the genotype SV-13 and SV-14 whereas, the remaining genotypes including var. Panniyur-1 showed filiform spike shape. Sasikumar *et al.*[9] recorded filiform type of spike in three black pepper vars. IISR Thevam, IISR Girimunda and IISR Malabar Excel. The loose arrangement of spike setting was noticed in genotypes SV-2, 3, 5 and SV-8 and compact setting was present in SV-4, 13, 15, 16 and SV-18 while, the Panniyur-1 and others were medium loose setting in nature. The arrangement of berries on the spike as very compact (133 berries/spike). Because of high productive bisexual flowers (98%) with a high setting percentage (91.5%), the berries are compactly arranged on the spike[4].

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

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	10.80	1.01
SV-2	8.88	46.67	Horizontal	17.24	11.18	2.15	12.87	0.36
SV-3	9.20	65.67	Hanging	17.00	8.01	2.93	12.03	0.98
SV-4	9.20	39.33	Semi-erect	17.43	12.37	2.66	10.70	0.80
SV-5	6.73	34.00	Horizontal	15.26	7.62	2.03	10.27	0.96
SV-6	6.00	37.67	Horizontal	17.12	11.31	2.03	10.57	0.81
SV-7	7.97	50.00	Horizontal	18.80	13.73	2.82	10.73	1.06
SV-8	9.40	60.00	Semi-erect	19.05	12.17	2.66	9.50	0.96
SV-9	8.13	30.67	Horizontal	18.97	12.62	2.07	10.07	0.72
SV-10	7.57	56.00	Semi-erect	19.47	12.21	2.16	12.83	0.98
SV-11	8.33	60.00	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	10.00	0.91
SV-15	3.67	64.67	Semi-erect	15.45	8.40	1.49	10.10	0.62
SV-16	8.50	32.00	Semi-erect	18.40	12.20	2.45	9.53	0.43
SV-17	8.67	67.33	Hanging	18.57	12.18	2.82	10.33	1.00
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	2.00	10.45	1.27
SV-20	8.53	76.00	Hanging	20.32	13.49	2.73	11.93	1.31
SV-21	9.37	52.00	Semi-erect	20.00	11.11	2.97	10.56	2.49
SV-22	8.23	52.67	Horizontal	18.50	11.72	2.14	10.50	2.19
Grand mean	8.13	57.03		17.97	11.33	2.36	10.92	1.06
S. Em±	0.40	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	12.50	4.30	3.64	18.47

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

Genotype	Leaf Venation	Leaf shape	Lamina shape	Leaf margin	Leaf texture	Shoot tip colour
Panniyur-1	Campylodromous	Cordate	Cordate	Even	Smooth	Light green
SV-2	Acrodomous	Round	Ovate lanceolate	Even	Smooth	Light purple
SV-3	Campylodromous	Round	Ovate lanceolate	Even	Smooth	Light purple
SV-4	Campylodromous	Round	Ovate–elliptic	Even	Rough	Light purple
SV-5	Campylodromous	Acute	Cordate	Even	Smooth	Light purple
SV-6	Eucamptodermos	Round	Ovate–elliptic	Even	Smooth	Dark purple
SV-7	Campylodromous	Round	Ovate–elliptic	Even	Rough	Light purple
SV-8	Campylodromous	Round	Ovate lanceolate	Even	Rough	Light purple
SV-9	Campylodromous	Round	Cordate	Even	Smooth	Light purple
SV-10	Campylodromous	Acute	Ovate lanceolate	Even	Smooth	Light purple
SV-11	Campylodromous	Acute	Cordate	Even	Rough	Light purple
SV-12	Campylodromous	Cordate	Cordate	Even	Smooth	Light purple
SV-13	Campylodromous	Acute	Ovate lanceolate	Even	Rough	Light purple
SV-14	Campylodromous	Acute	Ovate lanceolate	Wavy	Rough	Light purple
SV-15	Campylodromous	Acute	Ovate lanceolate	Wavy	Rough	Light purple
SV-16	Campylodromous	Round	Ovate–elliptic	Even	Smooth	Dark purple
SV-17	Campylodromous	Round	Ovate –elliptic	Even	Rough	Dark purple
SV-18	Campylodromous	Acute	Ovate lanceolate	Wavy	Rough	Light green
SV-19	Campylodromous	Acute	Ovate lanceolate	Even	Smooth	Light purple
SV-20	Campylodromous	Round	Ovate lanceolate	Even	Smooth	Dark purple
SV-21	Eucamptodermos	Acute	Ovate lanceolate	Even	Smooth	Light green
SV-22	Campylodromous	Round	Ovate lanceolate	Even	Smooth	Light purple

Table 3: Spike characters of different genotypes of black pepper (*Piper nigrum* L.)

Genotype	Spike setting	Spike twisting	Spike shape
var. Panniyur-1	Medium loose	Absent	Filiform
SV-2	Loose	Present	Filiform
SV-3	Loose	Absent	Filiform
SV-4	Compact	Absent	Filiform
SV-5	Loose	Absent	Filiform
SV-6	Medium loose	Absent	Filiform
SV-7	Medium loose	Absent	Filiform
SV-8	Loose	Absent	Filiform
SV-9	Medium loose	Absent	Filiform
SV-10	Medium loose	Absent	Filiform
SV-11	Medium loose	Present	Filiform
SV-12	Medium loose	Absent	Filiform
SV-13	Compact	Absent	Cylindrical
SV-14	Medium loose	Absent	Cylindrical
SV-15	Compact	Absent	Filiform
SV-16	Compact	Absent	Filiform
SV-17	Medium loose	Absent	Filiform
SV-18	Compact	Absent	Filiform
SV-19	Medium loose	Absent	Filiform
SV-20	Medium loose	Absent	Filiform
SV-21	Medium loose	Present	Filiform
SV-22	Medium loose	Absent	Filiform

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