

SCREENING OF BLACK PEPPER (*PIPER NIGRUM* L.) CULTIVARS FOR WATER STRESS

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ABSTRACT

A pot culture study was conducted to investigate the influence of water stress on relative water content and membrane stability of black pepper cultivars from January 1997 to March 1997. Water stress was imposed on eight month old rooted black pepper cuttings planted in polythene bags. Among the forty four varieties/cultivars grown in polythene bags, 15 wilted by second day of water stress and only six varieties viz., Kalluvally-4, Kumbakodi, Padarpan, Panniyur-5, Poonjarmunda and uthirankotta-2 survived even after four days of water stress. These varieties also showed high relative water content (RWC) and membrane stability (MS) under water stress.

Black pepper, the perennial climber is an important export earning crop of India and famous for its characteristic pungency and flavour. Moisture deficit from March to May is a major constraint in limiting productivity of black pepper in India (Vasantha, 1996). Moisture deficit affects the establishment of cuttings in the field and photosynthetic ability. Cultivation of drought tolerant variety is one of the solution to avoid decline in yield during water stress (Rajagopal and Balasimha, 1994). An understanding of physiological process associated with drought tolerance is a pre requisite for selecting drought tolerant varieties. The influence of water stress on relative water content and membrane stability, has been investigated in certain crops (Rajasekhar *et al.*, 1991 and Latha, 1998). The role of relative water content, cell membrane stability in imparting stress tolerance in black pepper varieties/cultivars to be studied.

Forty four black pepper cultivars obtained from the germplasm collections maintained at pepper garden of the department of plantation crops, College of Horticulture, Vellanikkara were screened in a pot culture experiment by with holding water for various duration till the plants showed symptoms of permanent wilting. Relative water content, membrane stability were calculated

daily, two days and four days after imposing water stress. Relative water content (RWC) was estimated using the standard formula,

$$\text{RWC \%} = \frac{\text{Fresh weight-dry weight}}{\text{Turgid weight-Dry weight}} \times 100$$

The cell membrane stability was studied by observing the leakage to the membrane under water stress. For this, ten leaf discs (0.1g) were floated in 15 ml distilled water for 3 hours. The leaf discs were removed and the electrical conductivity of the solution was measured. After the initial measurements, leaf discs were returned to original solution and boiled in distilled water for ten minutes. Leaf discs were removed and the solution was cooled. The electrical conductivity of the solution was determined again.

$$\text{Membrane stability} = \frac{\text{Initial electrical conductivity}}{\text{Final electrical conductivity}}$$

Relative water content of the forty four varieties/cultivars grown under no water stress, daily irrigation, two days water stress cycle and four days water stress cycles are presented in Table 1. In all the varieties tested the maximum relative water content was observed in plants without water stress. The daily irrigated plants of the varieties Kalluvally-1, Kalluvally-2, Panniyur-4 recorded RWC above 90 per cent.

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Table 1. Effect of water stress on relative water content (RWC) of black pepper varieties/cultivars

Varieties	Water stress levels		
	0	2	4
	RWC (%)		
Arassanimirtta	59.2 ^o	28.2 ^a	-
Arivalli	69.5 ^{K1}	-	-
Arikottanadan	71.4 ^P	-	-
Balankotta - 4	57.3 ^P	27.3 ^P	-
Balankotta - 2	62.3 ⁿ	21.0 ^r	-
Ceylon	87.4 ^{dk}	50.0 ^{sa}	-
Cheriyakaniyakadan	85.4 ^f	-	-
Cholamunda	65.2 ^m	-	-
Chumala	54.1 ^q	-	-
Kalluvally - 1	92.0 ^b	67.3 ^d	-
Kalluvally - 2	95.1 ^a	63.3 ^e	-
Kalluvally - 4	77.4 ^a	76.3 ^b	68.1 ^d
Kalluvally - 7	70.1 ^k	60.3 ^f	-
Karimunda	77.3 ^{sh}	-	-
Karimunda - 2	69.5 ^k	33.1 ^o	-
Karimkotta	68.2 ⁱ	-	-
Kumbakodi	87.1 ^{de}	82.3 ^a	73.3 ^a
Kottanadan - 1	82.3 ^{df}	30.4 ^p	-
Kottanadan - 2	52.2 ^r	-	-
Malligesara	75.4 ^l	37.3 ^m	-
Narayakodi	74.2 ^j	42.3 ^l	-
Neriyamundi	60.2 ^o	-	-
Nilamundi - 2	74.4 ^l	-	-
Nilamundi - 2	60.2 ^o	47.3 ^h	-
Nilgiri - 1	74.4 ^l	-	-
Nilgiri - 4	55.0 ^{pa}	-	-
Padarpan	74.4 ^l	67.4 ^d	62.0 ^f
Panniyur - 1	94.2 ^a	40.6 ^l	-
Panniyur - 2	56.4 ^p	30.5 ^p	-
Panniyur - 3	86.4 ^e	32.3 ^o	-
Panniyur - 4	90.2 ^c	38.3 ^j	-
Panniyur - 5	76.3 ^h	72.1 ^c	67.8 ^e
Perumunda	67.0 ^m	-	-
Perumkodi	74.0 ^l	20.2 ^r	-
Poonjarmunda	80.2 ^{fg}	76.1 ^b	70.8 ^c
Sreekara	79.8 ^{fg}	35.0 ⁿ	-
Sulliya	79.5 ^g	-	-
Thevurmundi	73.4 ^l	32.1 ^o	-
Thulakodi	78.5 ^g	-	-
TMB 1	75.3 ^l	35.2 ⁿ	-
TMB 6	72.3 ^k	39.3 ^k	-
Uthirankotta- 1	62.0 ⁿ	33.3 ^o	-
Uthirankotta -2	81.5 ^f	76.1 ^b	72.8 ^b
Veluthanamben	65.0 ^m	20.0 ^r	-

The interaction means followed by a common letter are not significantly different at 5% level by DMRT;

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A significant decrease in RWC was observed only 29 varieties were survived. Relative water content further decreased when plants were

Table 2. Effect of water stress on Membrane stability (MS) of black pepper varieties/cultivars

Varieties	Water stress levels		
	0 day	2 day	4 day
	MS (%)		
Arassanimortta	39.1 ^d	67.4 ^e	-
Arivalli	25.0 ⁿ	-	-
Arikottanadan	28.2 ^l	-	-
Balankotta - 4	44.3 ^c	91.3 ^b	-
Balankotta - 2	44.4 ^c	91.3 ^b	-
Ceylon	32.4 ^{hi}	74.4 ^d	-
Cheriyakaniyakadan	26.4 ^m	-	-
Cholamunda	34.1 ^s	-	-
Chumala	31.4 ^l	-	-
Kalluvally - 1	21.2 ^q	32.3 ⁱ	-
Kalluvally - 2	73.3 ^a	32.3 ⁱ	-
Kalluvally - 4	23.3 ^p	28.3 ^v	40.5
Kalluvally - 7	24.1 ^o	-	-
Karimunda	27.4 ^{bp}	-	-
Karimunda - 2	26.3 ^m	59.1 ^l	-
Karimkotta	27.3 ^{kn}	-	-
Kumbakodi	32.3 ^{hi}	38.5 ^o	41.8 ^b
Kottanadan - 1	17.4 ^r	21.4 ^w	-
Kottanadan - 2	26.5 ⁿⁱ	35.0 ^g	-
Malligesara	25.3 ⁿ	33.3 ^s	-
Naranyakodi	20.8 ^q	30.0 ^u	-
Neriyamundi	27.4 ^l	-	-
Nilamundi - 2	28.3 ^{kl}	-	-
Nilamundi - 2	25.3 ⁿ	66.4 ^l	-
Nilgiri - 1	28.4 ^{kl}	-	-
Nilgiri - 4	24.3 ^o	-	-
Padarpan	30.8 ^j	36.5 ^p	40.8 ^c
Panniyur - 1	29.0 ^{kl}	40.0 ⁿ	-
Panniyur - 2	32.0 ^j	42.3 ⁿⁱ	-
Panniyur - 3	24.2 ^o	49.0 ^k	-
Panniyur - 4	36.5 ^e	50.8 ^r	-
Panniyur - 5	27.3 ^{hi}	34.3 ^r	39.3 ^d
Perumunda	16.3 ^r	-	-
Perumkodi	25.2 ⁿ	-	-
Poonjaramunda	24.2 ^o	26.3 ^w	30.8 ^e
Sreekara	29.2 ^k	60.0 ^h	-
Sulliya	33.1 ^h	-	-
Thevurmundi	56.3 ^b	63.3 ^g	-
Thulakodi	28.1 ^l	67.3 ^e	-
TMB 1	16.4 ^s	96.3 ^a	-
TMB 6	26.3 ^m	43.3 ⁱ	-
Uthirankotta-1	35.3 ^f	-	-
Uthirankotta-2	31.2 ^l	43.3 ⁱ	47.3 ^a
Veluthanamben	22.4 ^p	26.3 ^w	-

The interaction means followed by a common letter are not significantly different at 5% level by DMRT.

exposed four days water stress and only six varieties viz., Kalluvally-4, Kumbakodi, Padarpan, Panniyur-5, Poonjaramunda and Uthirankotta-2 survived. In these varieties the RWC varied from 62 to 73 per cent even after four days of water stress. The lowest RWC

among the survived plants was in the variety Padarpan (40.8) and the highest in Kumbakodi (41.80).

Water stress significantly influenced the membrane stability of the varieties tested (Table 2). The membrane stability decreased significantly when the plants were subjected to water stress for two days; highest membrane leakage was observed in TMB1 (96.3) and lowest in Kottanadan (21.4). Only, six varieties survived after four days of water stress and the leakage was maximum in Uthirankotta-2 (47.3) and least in Poonjarmunda (30.8).

A stable RWC under the stress may be considered as one of the indices for screening water stress tolerant varieties. Earlier

reports also showed very good correlation between RWC and water stress tolerance (Balasimha and Daniel, 1988; Vasantha *et al.*, 1989; Voleti *et al.*, 1990 and Rajasekhar *et al.*, 1991).

Varieties which tolerated four days of water stress showed relatively less membrane leakage. Clarke and McCraig (1982) used membrane stability to evaluate water stress tolerance in wheat. Drought tolerant maize (Premachandra *et al.*, 1991) sorghum (Premachandra *et al.*, 1992) and coconut (Rajagopal and Balasimha, 1994) have shown reduced membrane leakage as compared to susceptible varieties.

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