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RELEASE OF CLONE BT19 AND BT20 FOR POVERTY REDUCTION IN TEA SECTOR OF BANGLADESH

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ABSTRACT

Bangladesh is a country of 140 million populations where poverty reduction is the prior challenge. With a low level of per capita income, Bangladesh needs to formulate a multi-sectorial strategy for poverty reduction. As Bangladesh is an agricultural based country poverty can be minimized by enhancing agricultural inputs to maximize our production. Tea is an important cash crop in our country. Vast population directly or indirectly depends on our tea industry. The present study was conducted to investigate yield, quality and drought performance of the two newly released variety named BT19 and BT20 by Bangladesh Tea Research Institute. The experiment was conducted at Bangladesh Tea Research Institute experimental farm where four test clones namely Sh/D/11/313, A/8/8, A/17/7, A/22/39 and a well renowned Indian clone TV1 used as a control. The experimental result revealed that amongst the four test clones A/17/7 and A/8/8 are statistically more high yielder and drought tolerant than the control. A/17/7 is more high yielding than A/8/8 but A/8/8 is more drought tolerant. So considering yield, quality and drought potentials, the test clone A/17/7 and A/8/8 have recently released as BT19 and BT20 respectively which can be used as improved planting material in our tea growing areas by small growers and small holders to increase our production, quality as well as job opportunities and national income to eradicate our poverty.

Keywords: *Test clones, yield performance, cup quality, drought, BTRI*

INTRODUCTION

Tea is one of the most important non-alcoholic beverage drinks worldwide and has been gaining further popularity as an important 'health drink' in view of its medicinal value. Bangladesh is one of the promising tea producing countries with an annual production of about 67 million kg amongst other tea producing counties (PDU, 2015). Currently Bangladesh has 169 tea estates spread over Sylhet, Maulvibazar, Habiganj, Chittagong & Chittagong Hill Tracts districts and Northern districts as well as 58 small holders and 550 small growers in Chittagong Hill Tracts districts and Northern districts (PDU, 2015).

The Bangladesh tea industry is one of the major sources of income for the national exchequer contributing 0.81% to the national GDP (ITC, 2015). In our country tea is grown in such areas where it is difficult to grow other crops. It employs 415622 people of ethnic minority directly. More than 45% of the total workers are female. Apart from the above number of workers, another 259000 persons are living within the tea industry as dependents of the workers (PDU, 2015). Besides about 800000 people indirectly depends on tea marketing, distribution, supporting industries, transportation, packaging industries etc. (Hossain, 2011).

With an objective of evolving planting materials with high yield and quality potential, the clonal selection programme of Bangladesh Tea Research Institute was initiated in 1959 and hybridization programme in 1965 (Rashid and Alam, 1990). With the continuation of clonal development process, BTRI has recently released another two improved "Standard Clones" in the name BT19 and BT20 in its released series of vegetative clones. The accession number of these two clones during selection and trial period was A/17/7 and A/8/8 respectively.

In our country, 56098 ha land area (48.48% of total tea cultivating area) is available for tea cultivation but till now they are of no use or vacant. On the other hand, the main reason of vacancy problem is the mortality of newly plantation due to drought condition. Again, area which is further suitable for tea cultivation is about 7677 ha (PDU, 2015). So, newly high yielding as well as quality and more tolerant tea variety is needed to solve these problems. Cultivating new high yielding and more drought tolerant tea varieties can be helpful to eradicate poverty by creating sustainable employment opportunities for marginal land owners as well as for landless mass population and optimum commercial utilization of fallow land in a land hungry country like Bangladesh. Considering the above circumstances, the specific objectives of the study were: 1) to evaluate the yield and quality of different test clones; 2) to observe the comparative physiological condition for drought tolerance amongst test clones; and 3) to select more high yielder and drought tolerant clone amongst test clones.

RESEARCH METHODS

The experiment was carried out with four test clones of tea in the experimental field of BTRI experimental farm, during the period from April, 1996 to 2013 December. Cuttings were collected from the selected bushes of Shumshernugger and Amo tea estates during 1994 which were raised at BTRI nursery. After rooting trial in the nursery the selected test clones, namely Sh/D/11/313, A/8/8, A/17/7 and A/22/39 were put to long term yield and quality trial during 1996 at BTRI Farm. The experiment was laid out in a 5m x 5m Latin Square Design (LSD) with 105cm x 60cm spacing of plot size. There were 25 plants per plot. An Indian clone named TV1 was used as a standard (control) for yield and quality comparison. The experiment is conducted in rainfed condition. Fertilizer mixture was applied as per BTRI recommendations (Anonymous, 1994 & 1998). For young tea (Decenter-Prune-Skiff-Prune-Skiff) and for mature tea (Light prune-Deep skiff-Medium skiff-Light skiff) pruning procedure were followed as per BTRI recommendations (Anonymous, 2002 & 1986). The green leaf was harvested at weekly interval during the plucking season starting from mid-March to mid-December throughout the experimental period. The made tea kg per hectare was also calculated on the basis of 23% recovery from green leaf and 15875 plants per hectare at 105 cm x 60 cm spacing. The quality performances were assessed after of manufactured by CTC method in the BTRI mini tea factory of all the test clones and control were assessed weekly by conventional organoleptic test and scored numerically. The clone which has yield between 3000-4000 kg^{-ha} called “Standard clone”. Quality scoring ranges are given below:

E = Excellent (34 to >34 out of 50)
AA = above average (32 to <34 out of 50)
A = average (30-32 out of 50)
BA = Below Average (<30 out of 50)

To assess the drought performance five plant sample of each test clone with each replication were collected at 3rd year to observe average depth of root and root shoot ratio. Leaf Water Potential, rate of Photosynthesis, Transpiration loss and Water Use Efficiency were masured by lychor.

To measure proline content, leaf sample was extracted using 3% aqueous sulfoselicylic acid. 2ml of the filtered was pipetted into the test tube and 2ml acid ninhydrin and 2ml glacial acetic acid were added to it. After incubated at hot bathing and ice bathing the separated toluene was measured at 520nm in a UV spectrophotometer against reagent blank. Total chlorophyll (sum of chlorophyll a & chlorophyll b) was calculated by leaf and diluted methanolic extract which was read at 470, 653 and 666 nm using UV-Visible spectrophotometer against methanol as blank. The Relative Leaf Water Content was measured by the method of Barrs and Weatherley (1962) and Chlorophyll Stability Index were measured by following equation developed by Kaloyereas (1958). Chlorophyll Stability Index (%) = (Optical density value of heated sample / Optical density value of unheated sample) X 100. All data were recorded and analysed statistically in MSTAT programme in a microcomputer. The mean values were adjusted by DMRT.

RESULTS AND DISCUSSION

Yield performance

The mean yield of green leaf (g/plant) over the experimental years at mature stage (6^{th}- 17^{th} year) is presented in Table 1. At standard productivity level, i.e. in the year of 6^{th}, 7^{th}, 8^{th}, 10^{th}, 11th, 13th, 14th, 15^{th} & 16^{th} yield variations were significant except in the year of 9^{th} 12^{th} and 17^{th}.

Green leaf yield was converted as made tea (kg per hectare) over the experimental period. From the Table 2, it was observed that there was a direct relation between pruning cycle and yield. Production of both green leaf and made tea were gradually increased from light pruning (LP), deep skiff (DSK), medium skiff (MSK) and light skiff (LSK). Hossain at 2014 found similar result while studying relation between pruning cycle and yield.

Average yield of made tea are also presented in Table 2. The highest yield was given by A/17/7 (3877 kg/ha) followed by A/8/8 (3685 kg/ha) and Sh/D/11/313 (3673 kg/ha) which were statistically similar. All the test clones gave higher production than control TV1 (3282 kg/ha).

Table 1. Mean yield of green leaf (g/plant) at mature stage (6^{th} –17^{th} year)

Clone	6^{th} Year LP 2002	7^{th} Year DSK 2003	8^{th} Year MSK 2004	9^{th} Year LSK 2005	10^{th} Year LP 2006	11^{th} Year DSK 2007	12^{th} Year MSK 2008	13^{th} Year LSK 2009	14^{th} Year LP 2010	15^{th} Year DSK 2011	16^{th} Year MSK 2012	17^{th} Year LSK 2013
Sh/D/11/313	731b	925b	1158a	1133b	596	949	1353	1192ab	951ab	980	1009	1175
A/8/8	693b	958b	1165a	1162b	575	966	1257	1215ab	958ab	999	1029	1178
A/17/7	702b	971b	1135a	1170b	759	1042	1220	1306a	1070a	1080	1045	1248
A/22/39	846a	1068a	1118a	1264a	752	1000a	1213	1310a	987a	1021	1051	1158
TV1	658c	792c	928b	1055c	476	846c	1171	1092b	874b	921	949	1090
LSD at 0.05	105	130.88	165.65	NS	140.82	106.47	NS	133.29	129.5	96.03	98.91	NS

Within column values followed by different letter (s) are significantly different by DMRT ($p \leq 0.05$)

Table 2. Comparative yield of 3 pruning cycles of BT19 and control TV1 (Made tea kg/ha) at mature stage (6^{th} – 17^{th} year)

Clone	Yield of 3 pruning cycle of 12 years				Average Yield (made tea kg/ha)
	LP	**DSK**	**MSK**	**LSK**	
Sh/D/11/313	2771b	3377b	4282a	4260b	3673b
A/8/8	2709b	3508b	4198ab	4326b	3685b
A/17/7	3081a	3760a	4136b	4530a	3877a
A/22/39	3147a	2530d	4114b	4541a	3583c
TV1	2563c	2920c	3709c	3939c	3282d

Within column values followed by different letter (s) are significantly different by DMRT ($p \leq 0.05$)

Quality performance

The overall quality performances of the test clones and TV1 control assessed by conventional organoleptic test are shown in Table 3. It was observed that the cup characters of all the test clones were categorized as "Above average" while the TV1 showed excellent cup quality. The four test clones consistently produced tea of above average quality. They have bright infusion, coloury liquour with useful strength and briskness.

Drought Performance

The drought performance are given at Table 4. A/8/8 and A/17/7 showed highest statistically similar results in case of Average depth of root at 3rd year, Root-Shoot Ratio, Proline Content, Photosynthesis and Water Use Efficiency; while A/8/8 gave best result at Chlorophyll Stability Index and lowest result at Leaf Water Potential and Transpiration which indicates A/8/8/ is more drought tolerant than other test clones. Kaloyereas at 1958, El-Nadi at 1969, Bota *et al*. at 2004, Damayanthi *et al*. at 2010 also concluded that higher value of average depth of root at 3rd year, root-shoot ratio, chlorophyll stability index, proline content, photosynthesis & water use efficiency and lower value of leaf water potential and transpiration indicates higher level of drought tolerance.

Table 3. Cup quality of different test clones (Average score of 12 years, from 2002 to 2013)

Test Clone	Infusion (10)	Liquour colour (10)	Briskness (10)	Strength (10)	Creaming down(10)	Total	Overall Quality
Sh/D/11/313	7.43ab	7.66b	7.41b	7.54b	3.29ab	33.3b	AA
A/8/8	7.49ab	7.54bc	7.3c	7.36b	3.08b	32.74c	AA
A/17/7	7.29b	7.58bc	7.23c	7.4b	3.18b	32.84c	AA
A/22/39	7.39ab	7.49c	7.33c	7.32b	3.07b	32.63c	AA
TV1	7.65a	7.8a	7.7a	7.94a	3.57a	34.64a	E
LSD at 0.05	0.26	0.14	0.30	0.30	0.32	0.69	

Table-4. Comparative physiological study amongst test clones and control TV1

Clone name	Avrg. depth of root at 3rd year (cm)	Root Shoot Ratio	Proline Content (µmol/g fr. wt)	Leaf Water Potential (LWP-bar) *	Total Chloro-phy. (mg g^{-1})	Chloro-phy. Stability Index (CSI%)	Photosy. (µmol m^{-2} s^{-1})	Transp. (m.mol m^{-2} s^{-1}) *	Water Use Effi. (µmol/m mol)	Relative Leaf Water Cont. (RWC %)
Sh/D/11/313	30b	0.29b	0.57b	9.60b	1.97b	90c	9.0b	1.95b	5.06b	63b
A/8/8	35a	0.32a	0.65a	9.10c	1.96b	94a	9.50a	1.25c	5.33a	62.0b
A/17/7	32a	0.35a	0.61a	9.50b	2.05a	92b	9.50a	1.95b	5.12a	74a
A/22/39	30b	0.28b	0.58b	9.50b	1.94b	92b	9.0b	1.97b	5.03b	62b
TV1	28.75c	0.24c	0.55b	10.30a	1.95b	88d	8.95b	2.15a	4.85c	69b

Within column values followed by different letter (s) are significantly different by DMRT ($p \leq 0.05$)
* Lower value indicates higher degree of drought tolerance

CONCLUSION

From the above discussion it could be concluded that the test clone A/17/7 was the highest yielder while A/8/8 was the highest drought tolerant performer. Considering above performance (ie. yield, quality and drought) A/17/7 and A/8/8 have recently released and renamed as BT19 and BT20 respectively as standard clones in BT series for commercial use of the Bangladesh tea industry. BT19 which is more high yielding than BT20 but BT20 is more drought tolerant. BT19 will obviously help small growers, small holders as well as tea estate owners to increase both their production and quality to maximize their profit. On the other hand, BT20 which is more drought tolerant can mitigate the problems at drought period which will minimize their maintenance costs and other losses. So, both the clones BT19 and BT20 can be useful material amongst the tea growing region to eradicate poverty in our country.

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