S.L.J. Tea Sci. **60** (1), 16-21, 1991, *Printed in Sri Lanka.*

PERFORMANCE OF PROMISING TEA STRAINS (*CAMELLIA SINENSIS* (L) O. KUNTZE) OF KANGRA VALLEY IN HIMACHAL PRADESH

K. L. Sharma, D. K. Sharma and S. K. Mishra
(Tea Experiment Station, Department of Horticulture and Forestry, H. P. Krishi Vishvavidyalaya, Palampur – 176062, India)

Studies were carried out to evaluate the field performance of six promising tea strains (40/20, 49/20, 36/35, 37/35, 47/35 and 80/36) in the nucleus block with respect to their survival, general growth characteristics and yield at the early stages of their establishment. The orthodox made tea samples were analysed for their chemical composition and quality parameters and were compared with the taster's evaluation reports.

Among these, strains 40/20 and 47/35 were most promising as they had excellent growth characteristics and showed an increase in cumulative yield of 20.6 and 39.8 per cent respectively over the general population yield of all strains. They also indicated better colour and brightness of orthodox black tea. The taster's valuations for quality assessment for the strains 40/20 and 47/35 were high and ranged from Rs. 38 to 43 and Rs. 40 to 45 per kg respectively.

INTRODUCTION

Tea populations raised from seeds, are highly heterogeneous and differ greatly in their yielding capacity and quality characteristics. To ensure higher yields and optimum quality the use of the right kind of planting materials in future plantings will have far-reaching consequences than any other factor. The selection of promising material from the existing seedling plantations and their multiplication by vegetative propagation offers a most useful tool for rapid improvement of planting material (Venkataramani, 1966, 1969, Bezbaruah, 1968).

Kangra tea of China hybrid nature has been reported to be the most suitable planting material in Kangra Valley in terms of survival, growth, resistance to pests, diseases and adverse climatic conditions (Mehta, Marwaha and Sharma, 1975). These plantations though low in yield (450 kg. made tea per hectare), are excellent in quality, being similar to those of Darjeeling. The tremendous variation existing in the plantations have been exploited in preliminary investigations on selection work (Sharma and Mishra, 1989). According to them six bushes, viz., 40/20. 49/20, 36/35, 37/35, 47/35 and 80/36 appeared to be promising strains in a population of 25,000 bushes with respect to yield potential, growth parameters, nursery performance and quality evaluations. The present study was undertaken in the nucleus block to evaluate these selected strains under the agroclimatic conditions of Himachal Pradesh for their growth performance and quality assessment.

MATERIALS AND METHODS

This investigation was carried out at the Tea Experiment Station of Himachal Pradesh Krishi Vishvavidyalaya, Palampur at an elevation of 1291 metres a m s l (36.6'

N and 76.3' E) under rainfed conditions (April-June is the dry period while July-September is the monsoonal period), receiving an average annual rainfall of 2800 mm. Eighty plants each of six strains, viz., 40/20, 49/20, 36/35, 37/35, 47/35 and 80/36 that were eighteen months of age in the nursery were planted in the field in August, 1983 in four rows plots (as suggested by Venkataramani and Padmanabhan, 1964) 120 x 90 cm apart on silty loam soil texture with an average pH of 5.5. At the end of the second year the survival per cent was recorded.

Yield records were maintained from the third to fifth year (period of frame formation) on an outturn of 25 per cent made tea.

Orthodox black tea samples were manufactured during the month of April in the miniature manufacturing unit from flush obtained in the fifth year (Wood and Roberts, 1964). Qualitative analysis for theaflavins (TF) and thearubigins (TR) as well as estimation of total colour (TC) and per cent brightness (B) was carried out as described by Wood and Roberts (1964) and Deb and Ullah (1968) for made tea. The bulk tea samples were evaluated by the Tea Tasters at UPASI and Calcutta.

After the preliminary investigation for yield potential and the nursery trials, the six selections were planted in the field.

RESULTS AND DISCUSSION

The data presented in Table 1 show that the strains differ markedly in their survival and growth pattern. At the end of the second year, the strains 40/20, 49/20, 47/35 and 80/36 showed excellent survival percentage in the field under rainfed conditions, but 37/35 exhibited extremely low survival and hence was deleted from further observations. The general growth characteristics of the strains in the field also exhibited marked differences among them. The plants of 40/20 were uniformly vigorous in growth with almost orthotropic habit and could be easily established in the field. The plants of 49/20 were somewhat slow growing in nature with poorly branching habit and small size of shoots. They are of the spreading type but with uneven growth resulting in poorly developed plucking surfaces. The strain 36/35 was very slow in growth with inadequate laterals, whereas the plants of 37/35 did not perform well in the field.The plants of the strain 47/35, appeared to be semi-spreading in habit with uniformly vigorous growth. These plants have the characteristic of developing larger laterals as well as of larger terminal shoots. This characteristic was unique amongst all the selections tested in the nucleus block. The leaf texture was thick thus becoming resistant to hails. The initial establishment was slow but after the second year there was quick growth and good ground coverage. Though selection 80/36 showed a good survival percentage, it flowered profusely and became dormant in early October. Venkataramani and Padmanabhan (1964) have evaluated the field performance of selections in the early years of establishment which form a basis for the final release of clones to the tea industry. Venkataramani (1963) has also reported that bushes showing early lateral growth are desirable, but the primary branches should be orthotropic and not plagiotropic, as bushes with orthotropic growth habit and early lateral branching appear to be high yielders. In addition to the nature of the bush, the size of the leaf is also an important factor as greater yields are obtained with bushes having larger leaves.

TABLE 1 – *Performance of promising Kangra tea strains (Per cent survival and growth characteristics in the nucleus block)*

Strain No.	Survival (%) as at July 1985	General growth characteristics
40/20	100	Vigorous and uniform growth, orthotropic with good branching habit, excellent rooter, establishes readily in the field, leaf pose semi-erect, dark green in colour, serrated margin. Shoot medium in size and pubescent. Plants are resistant to drought, frost and hails. Fairly resistant to pests and diseases.
49/20	93	Semi-orthotropic with poor branching habit, growth uneven, early rooter and good survival. Leaf pose semi-erect, dark green in colour. Shoot size small to medium and less pubescent. Plants are resistant to drought frost and hails.
36/35	33	Semi-orthotropic with poor branching habit, growth uneven, poor rooter and poor establishment in the field. Susceptible to drought and hails. Leaf pose semi-erect, light green in colour and less pubescent. Susceptible to aphids.
37/35	15	Semi-orthotropic, with poor branching habit, slow rooter poor survival in the field. Susceptible to drought and hails. Leaf pose light green in colour and glabrous. Shoot size medium to large.
47/35	87	Semi-orthotropic, vigorous and uniform growth with profuse branching (laterals) habit. Leaf pose semi-erect, light green with thick texture of leaf. Shoot size large and densely pubescent. Resistant to drought, frost and hails. Slow rooter, early and prolonged flushing, survival good.
80/36	89	Semi-orthotropic, poor branching, leaf pose semi-erect, poor growth, early dormancy. Survival good. Shoot size small to medium. Resistant to drought, frost and hails.

The mean yield of the strains 40/20 and 47/35 showed 20.6 and 39.8 per cent higher yield respectively over the general mean (Table 2). The higher yield of 40/20 was probably due to its orthotropic growth habit and uniform growth of shoots at the plucking surface in addition to its prolonged flushing behaviour during the early and late parts of the seasons. In the case of 47/35, though the bushes have semi-orthotropic growth habit, the development of larger number of lateral shoots was its unique feature which resulted in a larger number of pluckable shoots on the plucking surface. It is to be noted that this selection gave the highest yield among the different selections. The bushes which possess large number of plucking points per unit area of the plucking surface and flush early in the season with uniform growth of shoots in the plucking surface are most ideal. Moreover, the plants, where laterals begin to grow from the lower axils long before the mother shoots go banjhi are likely to produce higher yields (Grice, 1963, Barua and Bezbaruah, 1989).

TABLE 2 – *Yield (made tea, kg ha^{-1}) of promising Kangra tea strains from third to fifth year after planting in the field (1986-1988)*

Strain No.	Yield (made tea kg ha^{-1})* 1986	1987	1988	Mean	Per cent increase (+) or decrease (–) over mean yield
40/20	574	895	1164	878	20.6 (+)
49/20	267	517	672	485	33.4 (–)
36/35	470	633	823	642	11.8 (–)
47/35	608	1064	1383	1018	39.8 (+)
80/36	386	637	828	617	15.3 (–)
Mean	461	749	974	728	

*Calculated at 9259 bushes ha^{-1}, at an outturn of 25% made tea.

Qualitative Analysis

The tea shoots of different strains were analysed for their chemical constituents which are responsible in contributing to the colour and quality in a tea cup. The levels of TF is highest in strain 47/35 followed by that of 40/20 (Table 3). Correspondingly the Taster's assessment of teas made from all the strains revealed that those from 47/35 and 40/20 were superior to the rest (Table 4). In the case of the other strains the levels of TFs were lower, so were the Taster's evaluation as well. It is also to be noted that strain 47/35 had maximum colour while strain 40/20 had highest brightness (%). It seems that strain 47/35 has a happy blend of good colour with fair brightness and a touch of aroma while strain 40/20 although less coloury, has a sharp aroma as evidenced by the heavy brightness of its liquor. Thus from a chemical analysis as well as on the basis of organoleptic evaluation it would be desirable to embark on the large-scale planting of strain 47/35 and 40/20 if one is to upgrade the quality of teas in the Kangra Valley.

TABLE 3 – *Qualitative parameters of Orthodox black tea samples of different strains*

Strain No.	% TF	%TR	Total colour	% Brightness
40/20	0.27 (3.07)*	2.89 (9.80)	0.80 (5.13)	25.01 (30.00)
49/20	0.20 (2.56)	2.89 (9.80)	0.77 (5.03)	17.73 (24.88)
36/35	0.26 (2.91)	2.90 (9.87)	0.96 (5.74)	15.17 (22.95)
47/35	0.44 (3.80)	4.57 (12.38)	1.53 (7.03)	19.28 (26.06)
80/36	0.17 (2.34)	3.02 (9.97)	0.70 (4.80)	13.39 (21.47)
CD at P=0.05	0.07	0.09	0.14	1.08

* Angular transformed values.

TABLE 4 – *Taster's valuations and remarks for orthodox black tea samples of different strains*

Strain No.	Nominal values (Rs./kg)	Taster's remarks
40/20	38 to 43	Well twisted teas which are even and ungraded.
49/20	35 to 36	Well twisted teas which are even and ungraded.
36/35	32	Is blackish, light rolled teas.
47/35	40 to 45	Has preferable style, being more wiry, a little greyer.
80/36	32	Brownish type containing a good deal of open brown leaf.

CONCLUSION

The field performance, qualitative analysis of chemical constituents of made teas and the Taster's remarks for quality and comparative market valuations have indicated that the strains 40/20 and 47/35 are outstanding in yield and quality. The large-scale planting of these two strains could be expected to enhance the yield and quality of the teas produced in the Kangra Valley.

ACKNOWLEDGEMENTS

The authors express their gratitude to the Tea Board of India for partly financing the Tea Research Project. They are also grateful to the Director, UPASI Tea Scientific Department and Mr. Vijay Dudeja, Chairman, Tea Brokers (Pvt.) Ltd., Calcutta for arranging with their tasters to taste the tea samples and for their reports.

REFERENCES

BARUA, D. N. and BEZBARUAH, H. P. (1989). Selection of clones *TRA, Tea Encyclopaedia, 204 (B 6), 1-8.*

BEZBARUAH, H. P. (1968). Genetic improvement of tea in North East India – its problems and possibilities. *Indian J. Genet.* **29***(A),* 126-134.

DEB, S. B. and ULLAH, M. R. (1968). The role of theaflavins and thearubigins in the evaluation of black teas. *Two and a bud* **15***(3),* 101–102.

GRICE, W. J. (1963). Bush selection and vegetative propagation in Darjeeling. *Ind. Tea Assoc. Sci. Dep. Memo No. 3,* 1-22.

MEHTA, K. G. MARWAHA, B. C. and SHARMA, R. L. (1975). Evaluation of seed sources of tea (*Camellia sinensis* (L) O. Kuntze) in Kangra Valley (H.P.) *Himachal J. Agric. Res.* **2***(2),* 66-69.

ROBERTS, E. A. H. (1962). The chemistry of Flavonoid Compounds, ed. T. A. Geissman (Oxford Pergamon Press).

SHARMA, K. L. SHARMA, D. K. and MISHRA, S. K. (1989). Selection of promising strains of tea (*Camellia sinensis* (L), O. Kuntze) from tea plantations of Kangra Valley in Himachal Pradesh. *J. Plant. Crops.* **16**, 132-137.

VENKATARAMANI, K. S. (1963). Second Progress report on tea selection. *UPASI Tea Sect. Dep.* Bull. **22**, 1-5.

VENKATARAMANI, K. S. and PADMANABHAN, T. S. (1964). Third progress report on tea selection. *A. R. UPASI Sci. Dep. Tea Sect. for* 1963-64, 50-63.

VENKATARAMANI, K. S. (1966). Practical utilization of plant variability in tea. Proc. 13th Ann. Conf. *UPASI Tea Sci. Dep. Bull.* **25**, 3-7

VENKATARAMANI, K. S. (1969). Sundaram a promising tea clone of Southern India. Pro. 15th Sci. Conf. UPASI TEA Sci. Dep. Bull. **27**, 38-42

WICKREMASINGHE, R. L. and PERERA, K. P. W. C. (1973). Factors affecting quality, strength and colour of black tea liquors. *J. Nat. Sci. Council of Sri Lanka* **1**, 11-121.

WOOD, D. J. and ROBERTS, E. A. H. (1964). The chemical basis of quality in tea. III. Correlations of analytical results with tea tasters' reports and valuations. *J. Sci. Fd. Agric.* **15**, 19-25.