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Research Article

Line × tester analysis for yield and quality characters in Natu tobacco *(Nicotiana tabacum L)*

Y. Bharathi[1], S. Jaffarbasha[2] and J. Manjunath[2]

[1]Department of Seed Science and Technology, Seed Research and Technology Centre, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad-500030, India.
[2]Regional agricultural Research Station, Nandyal, Kurnool, 518502, India
E-Mail: bharathi_yerasi@yahoo.co.in

Abstract
Seven female lines were crossed with three males in a line × tester design. The resulting 21 hybrids along with 10 parents were evaluated for the combining ability and gene effects during 2012 *Kharif* season. The results revealed that there were significant differences among genotypes (parents and crosses) for yield and its component traits. The combining ability variance and the ratio of GCA to total genetic variance showed predominance of non-additive gene action for all the characters except plant height and days to maturity. The lines, Natu nunepalli and Viswanadha were found to possess significantly high GCA effects for yield and its component traits while the crosses Viswanadha x II-1872 and Natu (DWFC) x II-1871 exhibited significant desired SCA effects for first grade leaf yield and spangle score, respectively. From this study it was found that the parents Natu nunepalli and Viswanadha could be used for diallel selective mating for fostering greater recombination, especially in the yield traits. The results suggested that adoption of reciprocal recurrent selection would be the best method for improving the yield potential in natu tobacco.

Key words
Combining ability analysis, Lines, Testers, Natu tobacco

INTRODUCTION

Tobacco plays a prominent role in the Indian economy. Due to the growing awareness of alleged health risk factors associated with tobacco's conventional uses, research efforts need to be geared up for alternative uses of tobacco. Patel *et al*. (1985) reported that it is possible to make use of tobacco crop for the production of several agro based chemicals. Apart from these, tobacco plant also produces oil rich seeds. Tobacco seed oil is reported to be used in certain pharmaceutical preparations, in alkyd resins and in soap manufacture. It is also used as edible oil after suitable refining in Greece, Bulgaria and some other countries (Somayajulu and Murti, 1963). The information on the association of different yield components and their contribution to yield will largely benefit the breeder to evolve high yielding and stable varieties. Choice of parents for hybridization plays an important role in delivering high yielding genotypes. Combining ability approach is often employed to identify desirable parents and to know the gene action involved in the inheritance of the traits under consideration. Among the several methods for studying the mode of gene action, line × tester analysis helps in evaluation of a large number of genotypes and their combining ability besides being a more comprehensive tool for understanding the genetic basis of inheritance. It also provides information on gene action involved in the inheritance of quantitative characters and helps in the selection of breeding method for the improvement of yield and its components. Breeding programs for varietal improvement in this type of natu tobacco have been based mainly on the selection in locally adopted and hybrid populations. Selection of parents is important for developing superior hybrids and varieties.

MATERIAL AND METHODS

The experimental material consisted of seven diverse female lines of Natu tobacco with desirable characters

viz., WAF, Bhairavi, Prabhat, II-1876, Natu (DWFC), Natu–Noonepalli and Viswanadha were crossed with three male parents viz., II-1871, II-1872, II-1875 in line × tester mating design. Twenty one hybrids with ten parents were transplanted in randomized block design with three replications at Regional Agricultural Research Station, Nandyal during *Kharif* season of 2012. Each genotype was planted in six row plot of 7 m length with the spacing of 70 cm between rows and plants and recommended agronomic practices were followed to raise the crop. Apart from FYM @ 45 t/ha uniform basal dose of 40 kg N and 50 kg each of P_2O_5 and K_2O were applied. Observations were recorded on five randomly selected plants for plant height, leaf length, leaf breadth, internodes length, the number of leaves and on per plot basis for total cured leaf yield and first grade leaf yields, spangling and puckering scores and days to maturity. The analysis of variance was estimated according to the procedure developed by Kempthorne (1957) for obtaining the combining ability effects and variances keeping in view of suggestions of Arunachalam (1974). General analysis of variance was carried out separately for parents and hybrids following the procedures outlined by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Analysis of variance for combining ability (**Table 1**) indicated significant variances due to females for all the characters studied except for leaf length. The mean squares due to female lines were of larger magnitude in comparison to those due to male or female x male for all the characters except plant height, scores of spangling and puckering significant mean squares which indicated greater diversity among females and males for all the characters.

Table 1. ANOVA for combining ability for different characters in Natu Tobacco

Source of variance	d.f.	Plant height	Leaf length	Leaf breadth	Internode length	No. of leaves	Total cured leaf yield	First grade leaf yield	Spangling score	Puckering score	Days to maturity
Rep	2	192.67	50.47	10.40	4.73	0.87	0.58	0.24	1.04	0.32	90.14
Treat	30	113.21**	40.81**	48.07**	1.44**	2.52**	0.38**	0.08**	0.43**	0.36**	24.71**
Parent	9	171.45**	41.52**	85.43**	2.20**	4.68**	0.73**	0.13**	0.14	0.51*	48.14**
Cross	20	48.24**	42.41**	33.71**	0.75	-	-	0.07**	0.60**	0.43	13.92*
Female	6	71.14*	64.92	78.97**	1.38**	4.79**	0.56**	0.13*	0.80**	0.68**	30.40**
Male	2	121.94*	30.16	31.92	0.86	1.45**	0.18	0.04	1.91**	0.83**	1.64
Female x Male	12	26.92	34.45	11.57	0.32	0.36	0.07	0.04	0.24	0.06	9.19
Error	60	23.56	18.39	8.43	0.64	0.84	0.05	0.03	0.18	0.21	8.50

* and ** significant at 5% and 1 % respectively

Combining ability variance showed a higher specific combining ability variance than the general combining ability variance for all the characters except plant height and days to maturity. The variances due to GCA and SCA were not significant; however, the ratio of variance components due to GCA versus total genetic variance was less than 0.5 for all the characters indicating predominance of non-additive gene actions except plant height and days to maturity where it was greater than 0.5 indicating predominance additive gene action (**Table 2**). In this study, for the character which showed a predominant role of additive gene action could be best improved by following pedigree method of breeding and those showing predominance of non-additive gene action could be improved by cyclic method of breeding. Similar reports were obtained by kumar *et al*., (2005) in potato. Role of non-additive gene action for yield and related components had similarly been reported in tobacco by several workers (Gopinath *et al*., 1967; Jadeja *et al*., 1984; Swami *et al*., 1995).

Table 2. Estimates of variance components and their relative importance for yield and yield components

Characters	δ^2 GCA	δ^2SCA	δ^2GCA/δ^2GCA+ δ^2SCA
Plant height (cm)	2.012	1.906	0.504
Leaf length (cm)	0.857	5.286	0.143
Leaf breadth (cm)	2.106	6.851	0.212
Internode length (cm)	0.037	0.453	0.063
No.of leaves (No)	0.134	0.640	0.172
Total cured leaf yield (kg)	0.017	0.030	0.352
First grade leaf yield (kg)	0.004	0.014	0.160
Spangling score (1-5)	0.028	0.081	0.276
Puckering score (1-5)	0.021	0.150	0.116
Days to maturity (days)	0.608	0.236	0.709

Table 3. Estimates of GCA effects of parents for yield and yield components in Natu tobacco

Source	Plant height	Leaf length	Leaf breadth	Internode length (cm)	No.of leaves (No)	Total cured leaf yield (g)	First grade leaf yield (g)	Spangling score (1-5)	Puckering score (1-5)	Days to maturity (days)
Females										
WAF	-0.544	0.471	-3.343**	-0.134	-0.441	-0.323**	-0.128	0.484*	0.540*	-2.614*
Bhairavi	-0.267	-1.973	-1.787	0.211	0.449	0.033	0.065	-0.105	-0.059	0.185
Prabhat	2.589	-0.451	0.868	-0.035	0.741	-0.046	-0.041	-0.182	-0.182	1.610
II-1876	1.689	-0.006	1.657	0.442	-0.673	-0.016	-0.077	-0.271	-0.044	0.155
Natu (DWFC)	2.433	-3.23*	-1.387	0.421	-1.195*	-0.230*	-0.115	0.429*	0.161	-2.148
Natu–Noonepalli	-0.568	-0.195	-1.098	-0.535	0.694	0.236*	0.177*	-0.216	-0.06	0.155
Viswanadha	-5.422**	5.294**	5.391**	-0.379	0.305	0.377**	0.115	-0.138	-0.405	2.508*
Males										
II-1871	-1.552	0.991	1.089	-0.128	-0.208	-0.700	-0.300	0.352	0.156	-0.206
II-1872	2.490	0.381	0.094	0.245	-0.085	-0.037	-0.024	-0.133	0.029	-0.151
II-1875	1.028	-1.371	-1.263	-0.127	0.292	0.107	0.054	-0.219	-0.175	0.317
SE Female	1.483	1.428	0.909	0.279	0.343	0.076	0.060	0.146	0.162	0.984
SE	1.436	0.935	0.595	0.183	0.212	0.050	0.039	0.095	0.099	0.644

* and ** significant at 5% and 1 % respectively

Table 4. Crosses with significant SCA effects for different characters in Natu tobacco

Cross	Character	Value	SE
WAF x II-1875	Leaf length	-5.39	2.274
Viswanadha x II-1871	Total cured leaf yield	-0.315	0.137
Viswanadha x II-1872	First grade leaf yield	0.273	0.114
Natu (DWFC) x II-1871	Spangle score	0.514	0.222

The GCA effects of parents are presented in **Table 3**. Among the females, Viswanadha showed a significantly positive GCA for leaf length, leaf breadth, total cured leaf yield and days to maturity and significantly negative GCA effect for plant height, which was considered useful in chewing tobacco. The line Natu nunepalli showed significant a positive GCA for total cured and first grade leaf yields. Significant positive GCA effect was observed in the line Bhairavi for quality attributes like spangling and puckering scores and in the line WAF for spangle score. The parents Natu nunepalli and Viswanadha could be successfully utilized for the improvement of yield and yield components in chewing tobacco subjecting them to diallel selective mating for getting greater recombination. The parents which had registered positive and high GCA effects would be of much practical use in future breeding programmes aiming at crop improvement, as high GCA was reported to be related to additive or additive x additive interaction (Griffing, 1956a, Griffing, 1956b; Sprague and Tatum 1942). Amaranth and Murthy (1998) had reported that selections for leaf length would improve the total cured leaf yield in chewing tobacco. Non significant GCA effects were observed in males. Crosses WAF x II-1875 and Viswanadha x II-1871 exhibited significant negative SCA effects for total cured leaf yield and leaf length, respectively. Significant positive SCA effects were observed in crosses Viswanadha x II-1872 and Natu (DWFC) x II-1871 for first grade leaf yield and spangle score, respectively (**Table 4**). The genotype with good general combining ability and the crosses with a significant positive specific combining ability identified in this study could be utilized in further breeding programmes for improving yield and its related traits in chewing tobacco.

REFERENCES

Amarnath, S and Murthy, N.S. 1988. Path coefficient analysis in chewing tobacco. *Indian Journal of Genetics*. **48**(3): 93-96.

Arunachalam, V. 1974. Fallacy behind the use of modified line x tester design. *Indian Journal of Genetics*. **34**: 280-287.

Gopinath, D.M. Lakshminarayana, R. and Narayana C.L. 1967. The mode of gene action in Flue- cured tobacco. *Euphytica* **16**: 293-299. [Cross Ref]

Griffing, B 1956a. A generalized treatment of the use of diallelle crosses in quantitative inheritance. *Heredity* **10**: 31-50. [Cross Ref]

Griffing, B. 1956b. Concept of general and specific combining ability in relation to diallele crossing system. *Australian Journal of Biological Sciences*. **9**: 463-493. [Cross Ref]

Jadeja, G.C. Jaisani, B.G. and Patel G. J. 1984. Diallel study of some economic traits of bidi tobacco. *Tobbacco Research* **10**:58-63

Kempthorne, O. 1957. An Introduction to genetical statistics. John willey and Sons Inc., New York, USA. Pp-545.

Kumar, V, Jai gopal and Dhiman K.R. 2005. Combining ability analysis for tuber yield and late blight in potato. *Potato Journal*. **32**: 129-130.

Panse, V.G. and Sukhatme, P.V. 1967. Statistical methods for agricultural workers, ICAR, New Delhi.Pp.360.

Patel, B.K. Patel, J.A. and Chakraborty, M.K.1985. Maximization of tobacco protein production through agronomic practices. *Tobacco Research*. **11**:119-26.

Somayajulu, B.A.R and Murti, K.S. 1963. Pilot plant studies on processing of tobacco seed. *Indian Oilseeds Journal.* **7**: 312-9.

Sprague, G.F. and Tatum, 1942. General versus specific combining ability in single crosses of corn. *Journal of American Society of Agronomy*. **34**: 923-932. [Cross Ref]

Swami, A.V.S.R, Chari M.S and Reddy C.V.K. 1995. Diallel study for evolving superior varieties of FCV tobacco for Northern light soils of Andhra Pradesh. In Search for high quality. National Tobacco Symposium. Indian society of Tobacco Science. CTRI, Rajahmundry. P5.