

## TBST-2, A HIGH YIELDING MULTIPLE RESISTANT FCV TOBACCO LINE FOR TRADITIONAL BLACK SOILS OF ANDHRA PRADESH

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TBST-2 is a high yielding flue-cured Virginia tobacco line developed through interspecific hybridization between *Nicotiana gossei*, a wild relative of cultivated tobacco and *N. tabacum* cv. Hema. Wild species, *N. gossei* was identified as a source for resistance to tobacco aphid, *Myzus nicotianae*, which is an economically important insect pest on tobacco. With a view to incorporate aphid resistance from *N. gossei* to susceptible *N. tabacum*, cv. Hema was crossed with *N. gossei* and interspecific F<sub>1</sub> hybrids were obtained. Fertility was restored in a few segregating progenies through pedigree and back cross breeding and the resulting advanced cross derivatives with restored fertility were screened under artificial inoculation against tobacco aphid. Selections having aphid resistance in addition to normal fertility and desirable agronomic traits were further advanced. Subsequently, the aphid resistant progenies in F<sub>9</sub> and different back cross generations, were screened against TMV disease under artificial inoculation. A number of light cast and dark cast, resistant advanced interspecific cross derivatives were evaluated in replicated yield trials at CTRI, Rajahmundry. One among these lines, TBST-2 showed resistance to TMV besides tolerance to tobacco aphid was identified as significantly superior to the ruling traditional black soil varieties for cured leaf yield. In the station trials, TBST-2 showed an increase of 16 & 31% green leaf, 15 & 30% cured leaf, 25 & 27% bright leaf yield and 30 & 28% increase in grade index, respectively over the best check variety, VT 1158. In on-farm trials, TBST-2 with an average cured leaf productivity of 2799 kg/ha recorded more than 13% increase over Siri. In SLS, with an average productivity of 2189 kg/ha cured leaf yield, TBST-2 showed 15% improvement over Siri. The proposed variety TBST-2 showed maximizing yield potential at plant spacing of 70 x 50 cm with 45 kg N/ha. In view of its high yield potential, acceptable physical and chemical quality characteristics, resistance to TMV disease and moderate resistance to tobacco aphids,

TBST-2 was identified by the VIII AINPT Group Meeting (2015) and CTRI Institute Research Council for release for commercial cultivation in traditional black soils and southern light soils of Andhra Pradesh.

**Key words:** Breeding line, FCV tobacco, Multiple resistance, TBS

### INTRODUCTION

Tobacco aphid, *Myzus nicotianae* Black. is one of the most important insect pests on cultivated tobacco. Aphids retard the plant growth by sucking the sap and the 'honey dew' secreted by aphids favour development of sooty mold which renders the leaves unfit for curing. The loss in FCV tobacco due to aphid infestation is estimated to be around 30% under severe conditions. Hence, there is an urgent need to incorporate resistance to aphid attack into commercial tobacco cultivars. The presently grown *Nicotiana tabacum* cultivars are susceptible to green peach aphid, *M. nicotianae*. As there are no donors available in the primary gene pool, the only way to develop resistance is resorting to interspecific hybridization. Aphid resistant sources were identified among wild species of genus *Nicotiana* (Joshi *et al.*, 1978; Murthy and Ramaprasad, 2000).

### MATERIALS AND METHODS

With a view to incorporating aphid resistance from the aphid immune species, *N. gossei*, susceptible *N. tabacum*, cv. Hema was crossed with *N. gossei* and interspecific F<sub>1</sub> hybrids were obtained by overcoming the pre-fertilization incompatibility barriers (Murthy and Ramaprasad,

2000; Murthy and Subbarao, 2002). Extensive variability for aphid resistance was observed among the interspecific hybrids. Fertility could be restored in a few progenies through pedigree and back cross breeding and the resulting advanced cross derivatives with restored fertility were screened under artificial inoculation against tobacco aphid in experimental plots (on 1-5 infestation scale; 1 = highly resistant and 5 = highly susceptible) and selections for aphid resistance in addition to normal fertility and desirable agronomic traits were further advanced. Subsequently, selected aphid resistant progenies in  $F_9$  and different back cross generations, were screened against TMV disease under artificial inoculation. A number of light cast and dark cast, resistant advanced interspecific cross derivatives were evaluated in replicated yield trials at CTRI, Rajahmundry. One among these derivatives, coded TBST-2 showed resistance to TMV besides tolerance to tobacco aphid and was identified in preliminary yield trials as superior to the ruling traditional black soil varieties for cured leaf yield. The line TBST-2 was characterized for morphological traits.

The reaction of line TBST-2 to various tobacco related diseases and aphid was tested under natural or inoculated conditions in experimental plots. Two station replicated yield trials were conducted during 2004-05 to 2006-07 in randomized block design with 3 replications for testing yield potential and leaf quality of TBST-2 against the check varieties (VT 1158 and Hema in trial-1 and VT-1158, Hema and Siri in trial-2). Observations on leaf yield parameters were recorded by following the established procedure developed for Traditional black soil FCV tobacco. Optimum spacing and nitrogen levels were developed for TBST-2 and the treatments are as mentioned in the results and discussion. The chemical quality parameters nicotine, reducing sugars and chlorides were estimated (Harvey *et al.*, 1969).

## RESULTS AND DISCUSSION

### Distinguishing morphological characteristics of TBST-2

Plant has semi-erect habit, height 210 cm; plant width at 5<sup>th</sup> leaf position is about 86 cm as against 80 cm in Siri, thereby looking slightly

conical shaped. Stem light green to cream coloured, internode short to medium (5.5 cm on an average). Leaf lamina was very long, wavy, broad with good puckering and acute to acuminate tip. Leaf was moderately recurved, light green, sessile with medium auricle development. The average leaf length of 5<sup>th</sup>, 10<sup>th</sup> and 28<sup>th</sup> leaf were 58 cm, 70 cm and 24 cm, respectively and the width was 42 cm, 31 cm and 19 cm, respectively. The plant produced a total of 30 to 38 leaves with 27-33 economic leaves. Average weight of 100 cured leaves of TBST-2 was about 549 g against 500 g in Siri (picks 2-7). The cured leaf was lemon yellow to lemon-orange colour in lower plant positions and lemon-yellow to light orange in higher plant positions. Cured leaf was medium bodied, oily with good ripeness characteristics and good aroma. Flower length 63 mm, corolla 52 mm, throat diameter 15 mm; maturity starts from 70-75 days transplantation to flowering was 65-75 days, and the line takes 170-180 days from seed to seed. The larger leaf size, less internode length and slow maturity in TBST-2 as compared to check Siri seem to be the reasons for its higher yielding ability.

### Yield performance of line TBST-2

Two station replicated trials (2004-07 and 2006-09) were conducted for evaluating yield potential and leaf quality of line TBST-2 against check varieties and other advanced breeding lines in RBD (Tables 1a, b). In both the evaluation trials, TBST-2 showed an increase of 16 and 31% in green leaf, 15 and 26% in cured leaf, 25 and 27% in bright leaf yield and 14 & 28% increase in grade index, respectively over the best check varieties, VT 1158 and Siri.

In view of its superiority over check varieties in both the trials, line TBST-2 was subjected to multi-location trials under AINPT, IVT, AVT and bulk plot trials. The IVT was conducted at CTRI, Rajahmundry along with five other centres of AINPT during 2008-09 season. Line TBST-2 proved its significant superiority over better check varieties at Traditional Black Soil centers of Rajahmundry and Guntur and the Southern Light Soil centre at Kandukur (data not shown). It showed 10-22% increase in green leaf yield, 12-22% in cured leaf, 2-25% in bright leaf and 12-27% in grade index over better check varieties at these centers. In bulk evaluation trials conducted

**Table 1a: Performance of line TBST-2 (yield kg/ha) in station trial-1 (Pooled 2004-07)**

S. No.	Line/ Entry	Green leaf	Cured leaf	Bright leaf	Grade index
1	312-1S4 (TBST-2)	15062 (16)	2344 (15)	1076 (25)	1643(14)
2	55MX1-2-11	16431	2527	1190	1866
3	159-25-2-18	10256	1626	712	1102
4	178-3-3-10	12450	1935	923	1436
5	194-1-7-4	9386	1286	479	840
6	53MX1-19-13	12987	1997	928	1428
7	55MX1-22-3	14006	2209	1001	1549
8	178-3-3-24	12708	1916	994	1360
9	VT 1158	13024	2034	861	1433
10	Hema	11931	1800	722	1249
	Grand Mean	12808	1968	889	1391
	<b>SEm±</b>	<b>370</b>	<b>58</b>	<b>47</b>	<b>43</b>
	<b>CD (P=0.05)</b>	<b>1026</b>	<b>160</b>	<b>131</b>	<b>120</b>
	<b>CV (%)</b>	<b>8.67</b>	<b>8.79</b>	<b>16.00</b>	<b>9.35</b>
<b>Seasons</b>					
	2004-05	12319	1902	920	1399
	2005-06	11946	1840	699	1215
	2006-07	14207	2160	1047	1558
	<b>SEm±</b>	<b>243</b>	<b>33.34</b>	<b>47.41</b>	<b>28.88</b>
	<b>CD (P=0.05)</b>	<b>842</b>	<b>115</b>	<b>131</b>	<b>100</b>
	<b>CV (%)</b>	<b>10.39</b>	<b>9.28</b>	<b>14.59</b>	<b>11.37</b>
<b>Seasons x Entries</b>					
	<b>SEm±</b>	<b>641</b>	<b>99.8</b>	<b>82.1</b>	<b>75.1</b>
	<b>CD (P=0.05)</b>	<b>1778</b>	<b>277</b>	<b>228</b>	<b>208</b>

at CTRI, Rajahmundry during 2010-14 period, TBST-2 exhibited 8-50% increase over for cured leaf, 10-41% for bright leaf and 9-49% for grade index, respectively over check variety, Siri (Data not shown).

#### Reaction of TBST-2 to biotic stresses

The line TBST-2 showed resistance to TMV under artificial inoculation (Table 2). Farmers of SBS and SLS reported that TBST-2 have field tolerance to leaf blight against susceptibility of ruling variety, Siri.

#### Chemical quality parameters of TBST-2

The content of nicotine, reducing sugars and chlorides in cured leaf of line TBST-2 were in desirable range (Table 3). Also, TBST-2 has been reported to have superior leaf volatile flavor profile than the ruling variety, Siri (Srihari *et al.*, 2013).

#### Influence of N doses and plant population on performance of TBST-2

In the agronomic trial conducted to identify suitable fertilizer dose and plant spacing for the line TBST-2 during two seasons, 2011-12 and 2012-13, the line showed optimum performance with 45 kg N/ha and plant spacing of 70 x 70 cm (Table 4).

#### On-farm trials

In order to ascertain the farmers' acceptance, on-farm trials were conducted during 2013-14 season in SBS and SLS areas at 12 sites with TBST-2 along with Siri in collaboration with Tobacco Board, M/s ITC-ILTD and M/s GPI Ltd. In SBS, on an average TBST-2 recorded 2799 kg/ha cured leaf yield and recorded about 14% increase over Siri (2458 kg/ha). In SLS, with an average productivity of 2189 kg/ha cured leaf

**Table 1b: Performance of line TBST-2 (kg/ha) in station trial-2 (Pooled 2006-09)**

S. No.	Line/ Entry	Green leaf	Cured leaf	Bright leaf	Grade index
1	R 2-3 (TBST-2)	14914 (31)	2323 (26)	1340 (27)	1864 (28)
2	R 10-1	12558	2010	971	1505
3	R 22-2	10896	1696	761	1170
4	R 23-2	11921	1889	911	1470
5	R 48-1	11392	1784	934	1374
6	R 55-1	13128 (15)	2016 (9)	1205 (14)	1510
7	R 85-1	11053	1731	768	1286
8	R 87-1	11409	1785	934	1387
9	R 89-2	11318	1762	846	1325
10	Hema	10251	1646	805	1161
11	VT-1158	10896	1784	783	1298
12	Siri	11367	1842	1054	1461
	Grand Mean	11759	1855	943	1401
	<b>SEm±</b>	<b>341</b>	<b>45</b>	<b>30</b>	<b>40</b>
	<b>CD (P=0.05)</b>	<b>946</b>	<b>127</b>	<b>83</b>	<b>110</b>
	<b>CV (%)</b>	<b>8.71</b>	<b>7.40</b>	<b>9.51</b>	<b>8.50</b>
<b>Seasons</b>					
	2006-07	12316	1842	927	1465
	2007-08	10516	1744	858	1290
	2008-09	12444	1981	1044	1448
	<b>SEm±</b>	<b>313</b>	<b>31</b>	<b>32</b>	<b>25</b>
	<b>CD (P=0.05)</b>	<b>1042</b>	<b>107</b>	<b>111</b>	<b>88</b>
	<b>CV (%)</b>	<b>15.96</b>	<b>10.00</b>	<b>20.41</b>	<b>10.88</b>
<b>Seasons x Entries</b>					
	<b>SEm±</b>	<b>591</b>	<b>79.3</b>	<b>51.8</b>	<b>68.7</b>
	<b>CD (P=0.05)</b>	<b>NS</b>	<b>NS</b>	<b>144</b>	<b>NS</b>

Figures in parentheses indicate increase over best check variety.

**Table 2: Reaction of line TBST-2 to major diseases and insect pests, Katheru farm (season 2009-10 to 2013-14)**

S.No.	Disease	TBST-2	SIRI
1	Damping off*	S	S
2	TMV <sup>#</sup>	682 R : 4 S	0 R : 668 S
3	Black shank <sup>@</sup>	S	S
5	<i>Oroblanche</i> <sup>@</sup>	S	S
6	Leaf curl <sup>@</sup>	S	S
7	Tobacco aphid <sup>#</sup>	Score 2 (on 1-5 scale)	Score 5 <sup>\$</sup>
8	Tobacco caterpillar	S	S

\*, @ Recorded under natural conditions in experimental plots (about 84 plants each); R = resistant, S = susceptible; <sup>#</sup> Recorded under artificial inoculation; <sup>\$</sup>Varieties Hema and VT-1158 recorded a 5 aphid infestation score under artificial inoculation (2 = 50-250 aphids per plant; 5 = above 1000 aphids per plant).



yield, TBST-2 showed 15% improvement over Siri (1903 kg). Farmers expressed acceptability of proposed variety, TBST-2 both in SLS and SBS areas. It was observed that due to slow leaf maturity, TBST-2 allows about four days additional harvest interval as compared to Siri, thereby facilitating staggered harvest. Also, good establishment in field and faster growth, shorter internode length, more leaf size, resistance to TMV, field tolerance to blight and aphids, less per cent of low grade leaf are the clinching factors for adoption of the line TBST-2 by the farmers of SBS and SLS.

In view of its high yield potential, acceptable physical and chemical quality characteristics, resistance to TMV disease, moderate resistance to tobacco aphids, the advanced interspecific cross derivative, the line TBST-2 was identified by the VIII AINPT Group Meeting (2015) and CTRI Institute Research Council for release for commercial cultivation in traditional black soils and southern light soils of Andhra Pradesh. Release of TBST-2 would help the farmer in low productivity areas like southern light soils to improve and sustain the higher productivity levels.

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#### REFERENCES

- Harvey, W.R., H.M. Stahr and W.C. Smith. 1969. Automated determination of reducing sugars and nicotine alkaloids on the same extract of tobacco leaf. **Tob. Sci.** 13: 13-5.
- Joshi, B.G., G. Ramaprasad and S. Sitaramaiah. 1978. A note on the relative toxicity of some *Nicotiana* species to green peach aphid, *Myzus persicae* Sulz. **Tob. Res.** 4: 65-6.
- Murthy, T.G.K. and G. Ramaprasad. 2000. Aphid resistance in some *Nicotiana* species and interspecific hybrids. **Tob. Res.** 26: 52-6.
- Murthy, T.G.K. and I.V. Subbarao. 2002. Some new interspecific hybrids in the genus *Nicotiana* - Characterization and utilization. **Tob. Res.** 30: 33-41.
- Srihari, C.V.N., K. Siva Raju, T.G.K. Murthy, K. Sarala and C.V. Narasimharao. 2013. Neutral volatile compounds in FCV tobacco cultivars and breeding lines. **Tob. Res.** 39: 93-100.