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Research Article

High yielding, semi compact, drought tolerant, early maturing new samai variety ATL 1

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Abstract
A high yielding and early maturing Samai TNPsu 177 was developed at the Centre of Excellence In Millets, Tamil Nadu Agricultural University, Athiyandal and released as ATL 1. It is a derivative of CO(Samai) 4 x TNAU 141 with 1587 kg/ha grain yield and 3109 Kg/ha of straw yield in 85-90 days under rainfed condition. Being a short duration variety, this variety fits well in the existing double cropping rainfed condition of North, North western and western zones of Tamil Nadu. Samai is grown in June- July as a preceding crop to horsegram in more than 80,000 ha. It has yield advantage of 11.2 and13.7 percent for grain yield while11.8 - 14.4 percent for straw yield over the check varieties *viz.*,CO(Samai) 4 and Paiyur 2. Samai line TNPsu 177 has strong and sturdy culm with long, semi-compact panicles and drought tolerance. The plant has 6-8 productive tillers and non-shattering grains. It has special attributes like easy threshability, synchronous maturity and non-lodging growth habit. The grains are bold with attractive golden yellow colour. In view of stable yield performance across seasons and locations, special attributes and drought tolerance, Samai TNPsu 177 is proposed for release as ATL 1 to fulfill the long felt need of the drylands, hilly and tribal areas in Dharmapuri, Thiruvannamalai, Vellore, Salem and Krishnagiri districts of Tamil Nadu where samai is predominantly grown under rainfed condition.

Key words
Samai, ATL 1, high yielding, drought tolerant, early maturing

Introduction

A member of sub-family Panicoideae of the family Poaceae, Samai *(Panicum miliare L.)* (Syn. *Sumatrense* Roth ex Roem. and Schult] is widely cultivated as a cereal across India, Nepal, Western Burma, Sri Lanka, Pakistan and South East Asian countries. It is grown both in the tropical and sub tropical regions and even at an altitude of 7000 feet (Daniel Sundararaj and Thulasidas, 1993). The crop is hardy and provides reasonable harvest even in degraded soils under unfavourable weather conditions. Presently samai is grown throughout India in more than half a million hectare with major area including Karnataka, Andhra Pradesh, Tamil Nadu, Orissa, Bihar, Maharashtra and Madhya Pradesh. The crop is often sown with the onset of monsoon and is the first crop to be harvested in the season (Haider, 1997). Samai has high tolerance to heat and drought and highly suitable for extreme soil and climatic conditions. In Tamil Nadu, samai is grown in 20,000 ha during southwest (June-July) and northeast (September-October) monsoon with the productivity of 732 kg/ha^{-1} in Dharmapuri, Krishinagiri, Salem, Namakkal, Erode, Coimbatore, Madurai and Vellore districts. A high yielding, drought resistant and short duration culture is the long felt need of the dry land, hill area and tribal farmers of Tamil Nadu. With this objective breeding work was initiated and a new high yielding ATL 1 variety was developed to increase the production and productivity of samai in Tamil Nadu, where samai is grown predominantly under double cropped rainfed conditions.

Materials and Methods

Hybridization programme was handled with two varieties *viz.*, CO (Samai) 4 and TNAU 141.The selection of samai advanced line (TNSu 177) was done during 2012 and tested in Preliminary Yield Trail and Comparative yield trails during *kharif* 2012 to *kharif* 2014. This was proposed and tested in Multi Location Trails from 2015 -2017 at Aruppukotai, Athiyandal, Coimbatore, Paiyur, Vaigaidam, Virinjipuram. It was promoted to Adaptive Research Trails for three years during 2016-2017, 2017-18 and 2018-19. The performance was tested in 104 locations at different districts of Tamil Nadu. Field screening was also carried out for pests and diseases reactions.

Results and Discussion

The overall performance of the Samai TNPsu 177 in different trials was presented in Table 1. Station trail was conducted from *kharif* 2012 to *kharif* 2014, the culture recorded mean grain yield of 1859 kg/ha which was 15% percent increase over

CO (samai) 4 and 21.70 percent increase over Paiyur 2. The mean straw yield (3633 kg/ha) around 6.8 percent increase was obtained over CO(samai) 4 and 20.50 per cent increase over paiyur 2. (Table 2).

Multi Location trails were conducted during *kharif* 2015-17, Samai TNPsu 177 recorded a mean grain yield of 1464 kg/ha with 15% increase over CO (Samai) 4 and 2983 kg/ha of straw yield which is 28% more compared with CO (Samai) 4 (Table 3). TNPsu 177 was tested under Adaptive Research Trail during 2017-18 at 104 locations at farmers field and recorded 1002 kg/ha with 6.91 per cent and 7.81 per cent increased yield over CO 4 and

Paiyur 2 respectively (Table 4).On farm trial was conducted during 2016-2018, the culture recorded 2091 kg/ha of grain yield which is 9.3% and 10.85% more yield compared with the checks *viz*., CO 4 and Paiyur 2 respectively. Straw yield is 4071 kg/ha which is 12.08 and 13.97% increased yield compared with the checks *viz*., CO(Samai) 4 and Paiyur 2.

Large Scale Demonstrations was taken during 2016 to 2018 at Centre of Excellence, Athiyandal. TNPsu 177 recorded 2223 kg/ha of grain yield which is 10.40% more yield compared with check CO(Samai) 4 and 12.71% increased yield compared with check paiyur 2. Straw yield was 4106 kg/ha which is 11.5% and 14.27% more yield compared with the checks *viz*., CO(Samai) 4 and Paiyur 2. (Table 6).

Samai culture TNPsu 177 recorded less incidence of grain smut and sheath blight when compared with the check varieties CO (Samai) 4 and Paiyur 2.(Table 7). Samai culture TNPsu 177 recorded less dead heart symptom due to shootfly incidence when compared with the check varieties CO (Samai) 4 and Paiyur 2 under field condition (Table 8).

Regarding grain quality characteristics, Samai culture TNPsu 177 excels with the check varieties and was found to be the best for cooking and sensory evaluations.(Table 9). The grains are bold and attractive golden yellow in colour. The grains are nutritious with preferred grain qualities for cooking and value addition. The nutrient rich straw is palatable and highly suitable for cattle feeding. With high bulk density and milling out turn, the proposed variety is preferred by consumers and entrepreneurs.(Table 10)

As per the guidelines from PPV and FRA, New Delhi distinguishing morphological characters of the culture TNSu 177 was formulated and compared with the check variety CO(samai) 4 and Paiyur 2 . (Table 11). The proposed samai culture TNPsu 177 has strong and sturdy culm with long and semi-compact panicles. It is drought tolerant. The plant has 6-8 productive tillers and non-shattering grains. It is endured with special attributes like easy threshability, synchronized maturity and non-lodging growth habit.

In view of stable yield performance across seasons and locations and special attributes, with drought tolerance, the Samai culture TNPsu 177 is recommended for release by Crop Scientists Meet – Millets 2017 by TNAU, Coimbatore and released as ATL 1 by SVRC during 2018 for dry lands and hilly and tribal areas in Dharmapuri, Thiruvannamalai, Vellore, Salem and Krishnagiri districts of Tamil Nadu under rainfed condition

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Table 1. Overall performance of Samai culture TNPsu 177 under various trials

Name of the Trials	No. of trials	Grain Yield (Kg/ha)			Straw Yield (Kg/ha)		
		TNPsu 177	CO(Samai)4 *	Paiyur 2*	TNPsu 177	CO(Samai) 4 *	Paiyur 2*
Station Trials(2012-2014)	3	**1859**	1616	1528	**3633**	3401	3014
MLT (2015 –2017)	11	**1343**	1146	1125	2616	2054	2297
ART (2017-2018)	60	**954**	884	862	1960	1827	1772
ART - KVK (2017 -2018)	44	**1050**	990	997	2265	2079	2056
On Farm Trials (2016-2018)	51	**2091**	1912	1886	4071	3633	3572
Large Scale Demonstrations (2016-2018)	5	**2223**	2014	1972	4106	3687	3593
Mean of 174 trials		**1587**	**1427**	**1395**	**3109**	**2780**	**2717**
% increase over			**11.19**	**13.74**		**11.81**	**14.40**

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Table 2. Performance of Samai culture TNPsu 177 in Station Trials (2012-2014)

Year	Grain Yield (Kg/ha)			Straw Yield (Kg/ha)		
	TNPsu 177	CO(Samai) 4 *	Paiyur 2*	TNPsu 177	CO(Samai) 4 *	Paiyur 2*
kharif, 2012	2078	1879	1864	3950	3680	3423
kharif, 2013	2054	1958	1713	4010	3740	3209
kharif, 2014	1445	1012	1008	2940	2782	2410
Mean	**1859**	**1616**	**1528**	**3633**	**3401**	**3014**
% increase over	**-**	**15.04**	**21.70**	**-**	**6.82**	**20.50**

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Table 3. Two years MLT data of Samai cultureTNPsu 177 (11 locations)

S. No.	Entries	Yield (Kg/ha)	TNPsu 177			CO(Samai)4*			Paiyur 2 *		
			15-16	16-17	Mean	15-16	16-17	Mean	15-16	16-17	Mean
1	Aruppukottai	Grain	706	533	**620**	584	400	**492**	729	-	**729**
		Straw	1513	1006	**1260**	1230	844	**1037**	1322	-	**1322**
2	Athiyandal	Grain	2198	1836	**2017**	1778	1431	**1605**	2557	1336	**1947**
		Straw	3950	3503	**3727**	2880	2679	**2780**	3086	2423	**2755**
3	Coimbatore	Grain	1645	1768	**1707**	1675	1220	**1448**	1367	-	**1367**
		Straw	3343	3376	**3360**	3225	2285	**2755**	2712	-	**2712**
4	Paiyur	Grain	1081	548	**815**	830	533	**682**	800	-	**800**
		Straw	2980	1011	**1996**	1424	890	**1157**	1456	-	**1456**
5	Vaigaidam	Grain	-	1220	**1220**	-	1150	**1150**	-	-	**-**
		Straw	-	2351	**2351**	-	2217	**2217**	-	-	**-**
6	Virinjipuram	Grain	1692	-	**1692**	1483	-	**1483**	1783	-	**1783**
		Straw	3127	-	**3127**	2863	-	**2863**	2276	-	**2276**
	Mean	**Grain**	**1464**	**1181**	**1345**	**1270**	**789**	**1143**	**1447**	**1336**	**1325**
		Straw	**2983**	**2249**	**2637**	**2324**	**1783**	**2135**	**2170**	**2423**	**2104**
% increase over		Grain	-	-	-	15.28	49.69	**17.67**	1.17	37.43	**1.51**
		Straw	-	-	-	28.36	26.14	**23.51**	37.47	44.57	**25.33**

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Table 4. Performance of TNPsu 177 in ART (District wise mean): 2017-2018

Districts	Location	Grain Yield (Kg/ha)			Straw Yield (Kg/ha)		
		TNPsu 177	CO (Samai)4	Paiyur 2	TNPsu 177	CO (Samai)4	Paiyur 2
Dharmapuri	**8**	**1136**	1019	1059	**2268**	2118	2134
Thiruvannamalai	**12**	**965**	823	853	**2029**	1704	1751
Vellore	**16**	**955**	927	872	**2149**	2097	1775
Krishnagiri	**8**	**1065**	971	909	**2181**	2058	1937
Villupuram	**8**	**779**	679	635	**1561**	1386	1324
Nammakkal	**8**	**483**	434	455	**1069**	954	950
Erode	**10**	**1299**	1164	**1107**	2813	2359	2468
Coimbatore	**16**	**1032**	1050	1035	**2031**	2140	2103
Virudunagar	**16**	**934**	903	914	**1959**	1806	1840
Salem	**4**	**1181**	1323	1294	**2663**	2479	2811
Overall mean	**104**	**1002**	937	929	**2111**	1953	1914
Percentage increase			6.91	7.81		8.61	10.29

Table 5. Performance of TNPsu 177 in On Farm Trial (2016-18)

SI. No	Districts	No. of Trials	Grain Yield (Kg/ha)			Straw Yield (Kg/ha)		
			TNPsu 177	CO (Samai)4	Paiyur 2	TNPsu 177	CO (Samai)4	Paiyur 2
1	**Tiruvannamalai**	29	2102	1912	1887	4129	3643	3587
% increase over				**9.94**	**11.38**		**13.34**	**15.11**
2	**Vellore**	22	2079	1912	1885	4014	3622	3558
% increase over				**8.73**	**10.32**		**10.81**	**12.81**
Mean (51 Trials)			**2090.7**	**1912.1**	**1886.1**	**4071.3**	**3632.6**	**3572.4**
% increase over				**9.34**	**10.85**		**12.08**	**13.97**

Table 6. Large Scale Demonstration : Centre of Excellence in Millets, Athiyandal

SI. No	Season	Grain Yield (Kg/ha)			Straw Yield (Kg/ha)		
		TNPsu 177	CO (Samai) 4	Paiyur 2	TNPsu 177	CO (Samai) 4	Paiyur 2
1	*kharif* 16	2160	1975	1899	3980	3455	3364
2	*Rabi* 16 - 17	2232	2017	1997	4018	3510	3444
3	*kharif* 17	2246	2013	1998	4230	3980	3875
4	*Rabi* 17-18	2288	2086	2100	4185	3876	3758
5	*kharif* 18	2189	1977	1868	4115	3614	3523
	Mean	**2223**	**2013.6**	**1972.4**	**4105.6**	**3687**	**3592.8**
	% increase over		**10.40**	**12.71**		**11.35**	**14.27**

Table 7. Disease reaction of Samai culture TNPsu 177 under field condition

S. No	Entry	Grain smut (%)	Sheath blight (%)
1.	**TNPsu 177**	**1.85**	**2.06**
2.	**CO (Samai) 4**	**3.15**	**4.12**
3	**Paiyur 2**	**3.76**	**5.78**

Table 8. Pest reaction of Samai culture TNPsu 177 under field condition

S. No	Pests	Shootfly incidence (%)	Dead heart symptom
1	TNPsu 177	4.64	1.13
2	CO (Samai) 4	6.17	3.06
3	Paiyur 2	5.13	4.12

Table 9. Grain quality characteristics of Samai culture TNPsu 177

Sl. No.	Characteristics	TNPsu 177	CO (Samai) 4	Paiyur 2
a)	**Nutritional Quality**			
1.	Protein (%)	**7.9**	7.6	7.4
2.	Carbohydrate (%)	**64.2**	64.1	63.8
3.	Fat (%)	**4.8**	4.7	4.98
4.	Crude fibre (%g)	**10.4**	9.8	10.0
5.	Mineral matter (%)	**2.2**	1.9	1.8
6.	Phosphorus (mg/100g)	**336**	322	324
7.	Calcium (mg/100g)	**26**	25	265
8.	Iron (mg/100g)	**7.6**	7.0	7.3
9.	Bulk density (g/ml)	**0.72**	0.63	0.61
10.	1000 grain weight (g)	**3.1**	2.9	2.8
11.	Threshability (%)	**89.3**	86.7	87.4
12.	Milling (%)	**67.3**	64.5	65.0
b)	**Cooking qualities**			
1.	Water uptake (ml)	**980**	965	960
2.	Cooking time (min)	**28**	27	26
3.	Initial Volume (ml)	**100**	100	100
4.	Cooked volume (ml)	**748**	720	714
5	Initial weight (g)	**72**	63	61
6.	Cooked weight (g)	**768**	726	721
c)	**Sensory evaluation score (1-10)**			
1	Colour& appearance	**9.7**	9.0	8.7
2	Flavour	**9.5**	8.7	8.5
3	Texture	**9.6**	8.5	8.1
4	Taste	**9.8**	8.3	8.2

Table 10. Fodder quality characteristics of Samai culture TNPsu 177

SI.No.	Characteristics	TNPsu 177	CO (Samai) 4	Paiyur 2
1.	Dry matter (%)	**24.8**	29.5	28.7
2.	Crude protein (%)	**8.8**	7.8	7.5
3.	Crude fibre (%)	**23.6**	28.0	28.3
4.	Potassium (%)	**2.7**	2.1	2.2
5.	Phosphorus (%)	**0.36**	0.28	0.27
6.	Miner matter (%)	**3.78**	2.91	3.02

Source: KVK, Tiruvannamalai.

Table 11. Descriptors of Samai culture TNPsu 177

Sl.No.	Descriptors	TNPsu 177	CO (Samai) 4	Paiyur 2
1.	Growth habit	Decumbent	Erect	Erect
2.	Plant height [cm]	125-135	105-115	100-110
3.	Plant pigmentation	Green	Green	Green
4.	Number of basal tillers	8-10	10-12	8-10
5.	Culm branches	Absent	Present	Present
6.	Blade length of flag leaf [cm]	32-34	23-25	21-23
7.	Blade width of flag leaf [cm]	1.5-1.7	1.3-1.5	1.2-1.4
8.	Blade pubescence	Essentially glabrous	Essentially glabrous	Essentially glabrous
9.	Sheath length of flag leaf [mm]	18-20	15-17	12-14
10.	Sheath pubescence	Essentially glabrous	Essentially glabrous	Essentially glabrous
11.	Ligule pubescence	Strongly pubescent	Medium pubescent	Medium pubescent
12.	Degree of lodging at maturity	Slight	Slight	Medium
13.	Senescence	Actively growing	Actively growing	Actively growing
14.	Length of peduncle [mm]	21-23	18-20	15-17
15.	Peduncle exertion [mm]	13-15	14-16	13-15
16.	Length of inflorescence [mm]	41-43	35-37	30-32
17.	Number of primary inflorescence branches	20-25	15-20	13-17
18.	Number of nodes per primary axis of inflorescence	27-31	23-25	20-22
19.	Number of secondary inflorescence branches	13-15	12-14	8-10
20.	Inflorescence shape	Arched	Diffused	Diffused
21.	Compactness of inflorescence	Intermediate	Open	Open
22.	Colour of fruit	Golden Yellow	Light Brown	
23.	Colour of apiculus	Yellow	Brown	Brown
24.	Length of fruit [mm]	4.2-4.5	4.0-4.2	3.8-4.2
25.	Width of fruit [mm]	3.5-3.7	3.5-3.7	3.5-3.7
26.	Days to flowering	55-60	52-57	51-54

Fig. 1. Field view of Samai TNPsu 177 as ATL 1

Fig. 2. Grain and Rice of Samai TNPsu 177 as ATL 1

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