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Research Article

A new high yielding Spanish bunch groundnut variety BSR 2

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Abstract
The Spanish bunch groundnut variety BSR 2 is the cross derivative of VRI 2 x TVG 0004 It matures in 105 – 110 days. This culture is suitable for cultivation in rainfed and irrigated conditions. The culture BSG 0912 possess the advantage of bunch type growth with higher yield, more number of pods per plant, suitable for cultivation in all the groundnut growing districts of Tamil Nadu. The average yield of BSG 0912 under rainfed condition is 2222 kg/ha, which is 5.9, 18.3 and 19.1 per cent higher than VRI 8 (2099 kg/ha), CO 7 (1878 kg/ha) and VRI(Gn) 6 (1866 kg/ha) respectively. Under irrigated condition, this culture has the average yield of 2360 kg/ha with the yield increase of 15.5, 14.5 and 22.9 per cent over VRI 8 (2044 kg/ha), CO 7 (2061 kg/ha) and VRI(Gn) 6 (1920 kg/ha), respectively. The culture registered the shelling out turn of 70.2 per cent, oil content of 45.01 per cent and 100 Kernel weight of 41.0 g with preferable pod and kernel characters. The groundnut culture BSG 0912 possess moderate resistance to late leaf spot and rust diseases.

Key words
Groundnut, Spanish bunch, BSR 2, High yield

Introduction

Groundnut (*Arachis hypogaea* L.) also called peanut, is one of the most important oilseed crop in the world. It is known as a "wonder legume" for its flowering, pegging and pod formation pattern (Boraiah *et al.,* 2012). It is cultivated in tropical, subtropical and temperate countries between 40°N and 40°S. It is an excellent source of edible oil and protein while the main byproducts of the crop, namely oilcake and haulms, serve as important animal feed. It is a valuable cash crop cultivated by millions of small farmers throughout the world, because of its economic and nutritional value (Saha *et al.,* 2015). It is cultivated in more than 100 countries in 27.94 m hectare with an annual production of 47.10 m tonnes and productivity of 1686 kg/ha (FAOSTAT 2017). In India, groundnut is cultivated in an area of 5.3 m hectare with the production of 9.2 m tonnes and productivity of 1732 kg/ha (FAOSTAT 2017).

Groundnut kernels are regarded as healthy foods as their nutrient profile is balanced (Arya *et al.,* 2016). The kernels contain 48-50% oil, 10-20% carbohydrates, and 25-28% easily digestible protein, and provides 564 kcal of energy for every 100 g of kernels (Arya *et al.,* 2016). In addition, groundnut is a rich source of several micronutrients and health-enhancing components, including minerals, antioxidants, and vitamins along with some biologically active polyphenols, flavonoids, and isoflavones (Janila *et al.,* 2013)

In spite of so many health benefits of groundnut, the genetic diversity is very low due to its evolutionary origin from a single hybridization event. Hence, substantial progress has been made through conventional breeding approaches to improve the pod yield and tolerance to biotic and abiotic stresses. Losses caused by biotic and abiotic stresses are the most important factors contributing to yield gap. Among the biotic stresses, foliar fungal diseases, late leaf spot (LLS) (caused by *Phaeoisariopsis personata* Berk and Curt) and rust (caused by *Puccinia arachidis* Speg.) are widespread and are major production constraints in groundnut growing regions. They together are responsible for the reduction of 50 to 70% pod yield depending on severity of the infection besides having an adverse effect on seed quality (Subrahmanyam *et al.,* 1984, McDonald *et al.,* 1985). Development of LLS and rust resistant groundnut cultivars is a major breeding objective in groundnut to sustain the pod yield. Hence, a new Spanish bunch groundnut variety BSR 2 was developed by pedigree method of breeding with high pod yield and moderate resistance to late leaf spot and rust.

Materials and Methods

The hybridization was effected between VRI 2 and TVG 0004 during Kharif 2005 at Agricultural Research Station, Bhavanisagar. The F_1 and the consequent segregating generations from F_2 to F_5

were raised and selection was made based on single plant yield and field resistance to late leaf spot and rust. The homozygous high yielding F_6 progeny row with field resistance to late leaf spot and rust, identified and named as BSG 0912 was promoted for testing in Row Yield Trial during Rabi 2010-11. Later Preliminary Yield Trial, Comparative Yield Trial and Advanced Yield Trial were conducted in the station during Kharif 2012 to Rabi 2013-14. The culture BSG 0912 was proposed for testing in AICRP trials during Rabi 2013-14 in IET – I stage and then got promoted for testing in IET – II stage during Rabi 2014-15 in the national code name of INS I 2013-8. The culture BSG 0912 was nominated for testing in MLT in Kharif 2014 and in Adaptive Research Trial in Kharif 2016. A total of twenty On Farm Trials were conducted in various blocks of Erode district during Rabi 2016-17 and Rabi 2017-18. The culture was screened for biotic stress resistance in the AICRP trials and in RRS, Vridhachalam under field and artificial conditions. Based on the yield superiority in various trials conducted, the culture BSG 0912 was proposed for release as BSR 2 during 2018. In 2019, the State Variety Release Committee approved and released the groundnut culture BSG 0912 as BSR 2.

Results and Discussion

The groundnut culture BSG 0912 is the cross derivative of VRI 2 x TVG 0004, matures in 105 – 110 days. This culture is suitable for cultivation in rainfed and irrigated conditions. It possesses the advantage of bunch type growth with higher yield, more number of pods per plant, suitable for cultivation in all groundnut growing districts of Tamil Nadu. The average yield of BSG 0912 under rainfed condition is 2222 kg/ha, which is 5.9, 18.3 and 19.1 per cent higher than VRI 8 (2099 kg/ha), CO 7 (1878 kg/ha) and VRI(Gn) 6 (1866 kg/ha) respectively (Table 1.a). Under irrigated condition, this culture recorded the average yield of 2360 kg/ha with the yield increase of 15.5, 14.5 and 22.9 per cent over VRI 8 (2044 kg/ha), CO 7 (2061 kg/ha) and VRI(Gn) 6 (1920 kg/ha), respectively (Table 1.b).

In the station trials, the culture BSG 0912 recorded the average yield of 3212 kg/ha with 14.7 per cent increased pod yield over the check variety VRI 6 (2800 kg/ha) under rainfed condition (Table 2.a). In irrigated situation, the culture showed 3335 kg/ha with 17.6 per cent higher pod yield over VRI 6 (2835 kg/ha) (Table 2.b). In multilocation trials, the culture BSG 0912 registered 2279 kg/ha which is 48.2, 33.3 per cent increased yield over the checks VRI 6 (1538 kg/ha), CO 7 (1710 kg/ha) and on par with VRI 8 (2289 kg/ha) respectively under rainfed situation in twelve locations (Table 1.a) . In irrigated conditions, this culture recorded 2196 kg/ha with 16.7and 26.4 per cent higher pod yield than the check varieties CO 7 (1881 kg/ha) and VRI(Gn) 6 (1737 kg/ha) respectively in ten locations (Table 1.b).

In Adaptive Research Trials, the groundnut culture BSG 0912 recorded 2210 kg/ha which is 11.7 and 6.7 per cent increased pod yield over the check varieties CO 7 (1979 kg/ha) and VRI 8 (2071 kg/ha) respectively in rainfed conditions in eighty three locations (Table 1.a). Under irrigated conditions, this culture registered 2352 kg/ha with 11.5 and 15.1 per cent higher pod yield over the check varieties CO 7 (2110 kg/ha) and VRI 8 (2044 kg/ha) respectively in thirty seven locations (Table 1.b). In On Farm trials conducted in rainfed condition, the culture BSG 0912 showed 2095 kg/ha with 26.0 per cent higher pod yield than the local check (1663 kg/ha) in twenty locations (Table 1.a). In AICRP trials, with the national identity of INS I 2013-8, this culture was evaluated and had recorded 2281 kg/ha with 26.2 per cent increased pod yield over the best zonal check R 8808 (1808 kg/ha) in fourteen locations (Table 1.a).

The resistance to late leaf spot and rust was observed in Agricultural Research Station, Bhavanisagar, Regional Research Station, Vridhachalam and under AICRP trials in various locations (Table 3). The culture BSG 0912 showed moderate resistance to late leaf spot and rust. For resistance to sucking pests and defoliators, the study was done in Agricultural Research Station, Bhavanisagar, Regional Research Station, Vridhachalam. The groundnut culture BSG 0912 expressed resistance to aphids and moderate resistance to thrips and jassids. For defoliators, BSG 0912 had moderate resistance to cut worm, gram pod borer and leaf miner (Table 4).

The groundnut culture BSG 0912 registered the shelling out turn of 70.2 per cent, and 100 Kernel weight of 41.0 g with preferable pod and kernel characters (Table 5.a). The culture has the oil content of 45.01 per cent (Table 5.b). The culture BSG 0912 is highly preferred by the farmers because of the bunch nature having the preferable duration of 105-110 days with more number of medium sized pods and well developed kernels. The key morphological characters to distinguish BSG 0912 from other ruling varieties while seed production are the wide elliptic leaflet shape and tan colored testa as per the DUS characterization (Table 6). Due to the superiority of the groundnut culture BSG 0912 over the check varieties, it was

released as BSR 2 by the 49th State Variety Release Committee during 2019.

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Table 1.a) Abstract of performance of Groundnut culture BSG 0912 in various trials under rainfed condition for Pod Yield (kg/ha)

Trials	No. of trials/locations	BSG 0912	VRI 6	CO 7	VRI 8
Station	2	3212	2800	-	-
MLT	12	2279	1710	1538	2289
ART	83	2210	-	1979	2071
OFT	20	2095	-	1663	-
AICRP	14	2281	-	-	-
Weighted mean	**131**	**2222**	**1866**	**1878**	**2099**
Per cent increase			**19.1**	**18.3**	**5.9**

Table 1.b) Abstract of performance of Groundnut culture BSG 0912 in various trials under Irrigated condition for Pod Yield (kg/ha)

Trials	No. of trials/locations	BSG 0912	VRI 6	CO 7	VRI 8
Station	2	3335	2835	-	-
MLT	10	2196	1737	1881	-
ART	37	2352		2110	2044
Weighted mean	**49**	**2360**	**1920**	**2061**	**2044**
Per cent increase			**22.9**	**14.5**	**15.5**

Table 2.a) Performance of Groundnut culture BSG 0912 in station trials during *Kharif* season under rainfed condition at ARS, Bhavanisagar for Pod Yield (kg/ha)

S. No.	Season	Trial	BSG 0912	VRI 6
1.	*Kharif* 2012	PYT	3272	2680
2.	*Kharif* 2013	AYT	3152	2920
	Mean		**3212**	**2800**
	Per cent increase			**14.7**

Table 2.b) Performance of Groundnut culture BSG 0912 at station trials during *Rabi*season under irrigated condition at ARS, Bhavanisagar for Pod Yield (kg/ha)

S. No.	Season	Trial	BSG 0912	VRI 6
1.	*Rabi* 2012-13	CYT	3310	2800
2.	*Rabi* 2013-14	AYT	3360	2870
	Mean		**3335**	**2835**
	Per cent increase			**17.6**

Table 3. Reaction of Groundnut culture BSG 0912 against diseases under field condition
RRS, Vridhachalam

Culture / Check	2015-16		2016-17	
	Kharif	***Rabi***	***Kharif***	***Rabi***
LATE LEAF SPOT (1-9 SCALE)				
BSG 0912	4	5	5	5
VRI 2	9	8	9	9
VRI(Gn) 6	9	9	9	9
TMV 13	9	7	9	9
RUST (1-9 SCALE)				
BSG 0912	2	3	3	4
VRI 2	7	7	7	7
VRI(Gn) 6	7	7	7	5
TMV 13	7	7	7	6

(Source : Crop Scientists Meet on Oilseeds Report' 2016 & 2017)

ARS, Bhavanisagar (Rabi 2017-18)

Diseases	Score (1 – 9 scale)			
	BSG 0912	CO 7	VRI Gn 6	TMV Gn 13
Late leaf spot	3.5	5.0	8.0	7.0
Rust	3.0	4.5	7.0	6.0

Under AICRP trials (*Kharif*' 2013)

Culture / check	LLS (1-9)	Rust (1-9)	Stem rot (%)	Collar rot (%)	Alternaria (1-9)	PBND (%)		Dry root rot (%)
						60DAS	90DAS	
BSG 0912	2	2	6.8	9.1	3	0.0	4.8	0.0
TAG 24 (ZC)	4	5	62.9			3.1	9.4	0.0
GG 6 (ZC)			10.1	9.1	4			

(Source : Annual Progress Report on AICRP-Groundnut' 2014)

Table 4. Reaction of Groundnut culture BSG 0912 against insects under field condition

RRS, Vridhachalam

Insect pest	*Kharif* 2015		*Rabi* 2015-16		*Kharif* 2016		*Rabi* 2016-17	
I.Sucking pests	BSG 0912	VRI-6	BSG 0912	VRI-6	BSG 0912	CO 7	BSG 0912	CO7
a. Aphids	Nil	Nil	Scale-1	Scale-1	Nil	Scale-1	Nil	Scale-1
b. Thrips	Scale-3	Scale-4	Scale-4	Scale-4	Scale-3	Scale -4	Nil	Nil
c. Jassids	Scale-2	Scale-2	Scale-2	Scale-2	Scale-2	Scale -2	Scale -2	Scale -2
II.Defoliators								
a. Cutworm	Scale-2	Scale-3	Scale-3	Scale-4	Scale-2	Scale-3	Scale-3	Scale-3
b. Gram pod borer	Scale-2	Scale-4	Scale-2	Scale-2	Scale-2	Scale-3	Scale-1	Scale-2
c. Leafminer	Scale-3	Scale-5	Scale-1	Scale-3	Scale-3	Scale-5	Scale-1	Scale-1

(Source : Crop Scientists Meet on Oilseeds Report' 2016 & 2017)

ARS, Bhavanisagar

Insect pest	*Rabi 2017-18*		*Kharif 2018*	
I.Sucking pests	BSG 0912	VRI-6	BSG 0912	VRI-6
a. Aphids	Scale -1	Scale -1	Scale -1	Scale -1
b. Thrips	Scale -2	Scale -2	Scale -3	Scale -4
c. Jassids	Nil	Nil	Nil	Nil
II.Defoliators*				
a. Cutworm - *S. litura*	Nil	Nil	Nil	Nil
b. Gram pod borer – *H. armigera*	Nil	Nil	Nil	Nil
c. Leafminer – *A. modicella*	Scale-1	Scale -3	Scale -3	Scale -3

Table 5. a) Quality traits of Groundnut culture BSG 0912

Characters	BSG 0912	VRI(Gn) 6	VRI 8
100 Kernel weight(g)	41.0	33.0	44.0
Shelling (%)	70.2	66.5	70.0
Moisture (g)	8.51	8.52	8.54
Lipid (g)	46.38	45.23	46.45
Free fatty acid Mg (KOH/g)	1.10	1.12	1.14
Peroxide value (Mill moles/1000g)	0.25	0.3	0.2

(Source : Community Science College and Research Institute, Madurai)

Table 5.b) Oil content of Groundnut culture BSG 0912

Entries / Oil content	BSG 0912	TMV 14	CO 7	VRI 8	VRI 6
Oil content	45.01	46.35	48.29	44.51	42.85

(Source : GKVK, Bangalore/ Department of Oilseeds, TNAU, Coimbatore)

Table 6. Morphological Description of Groundnut culture BSG 0912

1	**Plant habit**		
1.1	Life form	:	Annual
1.2	Growth habit	:	Erect (Spanish bunch)
2	**Stem characters**		
2.1	Branching pattern	:	Irregular with flowers on main stem
2.2	No. of branches	:	Primary : 4-6 Secondary : 6-9
2.3	Plant height (cm)	:	45-49
2.4	Stem pigmentation	:	Absent
2.5	Stem surface	:	Subglabrous
3.	**Leaf characters**		
3.1	Leaflet shape	:	Wide elliptic
3.2	Leaflet size	:	Medium
3.3	Leaf colour	:	Green
3.4	Leaf pubescence	:	Almost glabrous on both sides
3.5	Leaflet margin	:	Entire
3.6	Leaflet tip	:	Obtuse
4.	**Pod characters**		
4.1	Pod beak	:	Slight
4.2	Pod size	:	Medium
4.3	Kernel nature	:	Two seeded rarely one seeded
4.4	Constriction	:	Slight
4.5	Reticulation	:	Moderate
4.6	Shelling out-turn (%)	:	70.2
5.	**Kernel characters**		
5.1	Kernel size	:	Medium
5.2	Testa colour	:	Tan
5.3	100-kernel weight (g)	:	40 - 43 (Medium)
6.	**Maturity**		
6.1	Days to emergence	:	6-7 days
6.2	Days to 50% flowering	:	24-27 days
6.3	Days to maturity	:	105-110 days