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Study on Impact of Farmer's Participatory Varietal Selection in Groundnut (*Arachis hypogeae* L.) Improvement

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A B S T R A C T

The experiment was conducted during kharif-2015 and rabi/summer 2015-16 in selected districts of Hyderabad-Karnataka region. Farmer's Participatory Varietal Selection approach was used to evaluate 10 groundnut varieties in farmer fields by the farmers. Based on pooled mean performance of test genotypes for dry pod yield (kg/ha) across locations during kharif-2015, the test genotypes GPBD-5 (1572 kg/ha), Kadiri-9 (1492 kg/ha) and ICGV-00351 (1481 kg/ha) were found to be statistically significant over local check (1267 kg/ha) and in rabi/summer, the ICGV-00351 (1693 kg/ha), GPBD-5 (1649 kg/ha) and Kadiri-9 (1589 kg/ha) were performed statistically significant over local check (1406 kg/ha) across the locations. With respect to farmers preference during kharif, Kadiri-9 (22.70 %), GPBD-5 (15.52 %) and Dharani (15 %) were most preferred varieties, where in rabi/summer, Kadiri-9 (22.70 %), Dharani (16.91 %) and GPBD-5 (12.84 %) were most preferred varieties. The varietal preference among the groundnut stakeholders revealed that, Kadiri-9 being most preferred variety with total rankings of 19, which is followed by ICGV-00351, Kadiri-haritendra, TPG-41, TMV-2, G2-52 and GPBD-5 with total rankings of 18 based on the mean preference of the traits like Seed size, seed shape, test a colour, pod size, pod shape, pod filling, shelling (%), oil content and market price.

Introduction

The groundnut is one of the important crop of tropical and semiarid tropical countries, ranks 6th in world edible oil production among the oilseed crops and 3rd most important source of vegetable protein. It is consumed directly as raw, roasted and boiled nuts or processed into confections and groundnut flour for flavour enhancement or crushed for edible oil and industrial uses including haulm and shell used as fodder (Pande *et al.,* 2003; Upadhyaya *et al.,* 2006). Despite of its diversified uses, groundnut cultivated area declining year by year since two decades as illustrated by significant decline in area from 0.85 m ha in 2001-02 to around 0.65 m ha in 2013-14 (Ministry of agriculture, Govt. of India). In Karnataka the productivity is very low at 863 kg ha-1 compared to the national average about 1764 kg ha^{-1} in 2013-14 (Ministry of agriculture, Govt. of India).

The lower productivity in groundnut is mainly due to various biotic and abiotic stresses. Apart from these, cultivation of age old varieties which are vulnerable to majority of pests and diseases and non-availability of improved quality seeds also plays role. Many a times, improved varieties will not reach to

farmers due to inefficient extension system and they may not meet the expectations of farmers, trader's, agro-based industries and other stakeholders. In Karnataka TMV 2 occupies larger area due to premium price it fetches in the market because of its uniform pod and kernel features and wider adaptability but highly susceptible to pest and diseases. In order to address this problem, it has become essential to develop varieties that are high yielding with better pod and kernel features similar to TMV 2 and have wider adaptability.

Participatory plant breeding is the development of a plant breeding programme in collaboration between breeders and farmers, marketers, processors, consumers and policy makers (Walker, 2007 and Joshi and Witcombe, 1995). It's found to be effective and efficient tool in disseminating the improved varieties to farmers and to address present and future issues in farming. It acts as a bridge between scientific community and farmers wisdom, hence this mutual effect bring sustainability in crop improvement, which ultimately results in economic benefit and secured livelihood (Ceccarelli and Grando, 2007). With a view to introduce new varieties, the Farmers' Participatory Varietal Selection (FPVS) programme was implemented during in selected districts of Hyderabad-Karnataka region.

Materials and Methods

The experiment was conducted during kharif-2015 and rabi/summer 2015-16 in selected districts of Hyderabad-Karnataka region. Prior to this needs of the farmers were assessed to set goals and identify farmers preference and perception on ideotype of groundnut cultivars. Based on assessments nine high yielding groundnut genotypes (Table 1) were selected from various research institutes across India along with farmer's variety as check. The experiment was implemented through Mother-baby approach (Snapp, 1999) in the villages of selected districts in Hyderabad-Karnataka region where groundnut cultivation is predominant (Table 2). From each village 11 beneficiary farmers were selected to conduct the experiment, among 11 farmers one farmer will conduct mother trail which means it includes all the ten genotypes and rest of the ten farmers will conduct baby trails in paired comparison *i.e.*, V1+V2, V2+V3...V10+V1 (Fig. 1, Table 2). Hence there will be three replications for each variety in a village. Each mother trail comprised of 1000 m2 area where baby trails were of 200 m2 area. In a trail, each variety was sown 10 rows with spacing of 30×10 cm by following necessary agronomic practices. The experimental kit (seeds, plant protection chemicals and micronutrients) was distributed to all the beneficiary farmers to conduct the experiment in a precise manner. Regular field visits were made at a fortnight interval to each location.

A uniform area (100 cm2) of each variety were used to record the observation on dry pod yield (kg) then converted to dry pod yield (kg/ha). Farmers preference towards varieties were recorded during field days organized at mother trail site using questionnaires and farmers were asked to select the top three varieties with preference of I, II and III accordingly, then percent preference towards each genotype was worked out. Preference of other stakeholders like traders, oil millers, extension workers, seed production agencies and agriculture related officials were recorded by organizing the on-campus training programme using simple ranking method. Stakeholders were asked to rate the varieties from "1" being least preferred, "2" is preferred and "3" being most preferred for each trait. Mean ranking for the traits i.e.. seed size, seed shape, testa colour, pod size,

pod shape, pod filling, shelling (%), oil content and market price were worked out using 'matrix ranking' method (Bucheyeki *et al.,* 2008).

Results and Discussion

The dry pod yields (kg/ha) of all test genotypes across the location and seasons are presented in table 3. It was revealed from the results that, in kharif, GPBD-5 (1573 kg/ha), Kadiri-9 (1492 kg/ha) and ICGV-00351 (1481 kg/ha) were statistically significant over farmers variety TMV-2 (1276 kg/ha). Where in rabi/summer, ICGV-00351 (1693 kg/ha), GPBD-5 (1649 kg/ha) and Kadiri-9 (1589 kg/ha) were significantly superior than TMV-2 (1406 kg/ha). Similarly, Adu-Dapaah *et al.,* (2004 & 2007), Natre *et al.,* (2008) and Vindhiyaraman *et al.,* (2010) reported the higher yields of ICRISAT groundnut genotypes over local checks. Where, success of improved barley lines in Syria (Veroony *et al.,* 2003), aromatic rice (pokhreli jethobodo) in Nepal (gyawali *et al.,* 2010) and GDRM-187 maize variety in Rajasthan (Gramina vikas trust, 2002) through participatory research approach also reported. Interestingly, it was observed that dry pod yields (kg/ha) of all the genotypes were high in rabi/summer compare to kharif season. It may be attributed as rabi/summer crop will be taken under assured irrigation conditions where in kharif season, mostly under rainfed conditions.

Magnitude of G×E interaction in a variety decides its fitness in particular agro-climatic zones. G×E interaction is a good indication of biotic and abiotic factors affecting the crop production in their respective areas (Benziger *et al.,* 2006). In the present study, experimental sites were located in two major agro-climatic zones of Karnataka *i.e.,* North eastern dry zone and northern dry zone, hence, as expected each variety shown difference in yield performance in different location. Similarly Bucheyeki *et al.,* (2008) reported G×E interaction in test genotypes. The dry pod yields (kg/ha) of all varieties in each location are presented in table 3. In kharif, test genotypes found to be significantly better than TMV-2 (1275 kg/ha) in each location *i.e.,* in Golapalli (TG-37A:1496 kg/ha, Kadiri-9: 1423 kg/ha and Kadiri Haritandra:1384 kg/ha), Shrinivasapura (ICGV-003521: 1659 kg/ha, GPBD-5: 1611 kg/ha and Kadiri-9: 1409 kg/ha), Chikkakolache (GPBD-5: 1891 kg/ha, G2-52: 1629 kg/ha, Kadiri -9: 1546 kg/ha), Sasvigera (TPG-41:1591 kg/ha, Kadiri -9: 1524 kg/ha and GPBD-5: 1452 kg/ha) and Thigari (Kadiri-9: 1565 kg/ha). During rabi/summer, at Golapalli (Kadiri-9: 1713 kg/ha, Dharani:1681 kg/ha and ICGV-00351: 1638 kg/ha), Gogi tanda (ICGV-00351: 1804 kg/ha), Chikkakolache (GPBD-5: 1819 kg/ha), Sasvigera (GPBD-5: 1648 kg/ha, TG-37A:1645 kg/ha, Dharani: 1626 kg/ha) and in Thigari (ICGV-00351: 1830 kg/ha, Kadiri-9:1674 kg/ha, Kadiri haritanra: 1671 kg/ha) genotypes were better yielder than farmer variety. It can be inferred from the studies that Kadiri-9, ICGV-00351 and GPBD-5 found to be more or less stable yielder across the location and over seasons. Similarly, Bucheyeki *et al.,* (2008) reported the stable yields of Pendo and Johari groundnut varieties in Nigeria.

Varietal preference analysis

In varietal preference analysis, a simple ranking by the farmers based on their selection criterion were used. At harvest/field days, farmers were asked to rank the top three varieties based on their selection criteria. It was observed that most of the farmers were preferred varieties based pod features and haulm quality. The preference towards genotypes is presented in table 4. In Kharif, a total of 1392 ranking were recorded from farmers, out of which Kadiri-9 was most

preferred variety with 316 (22.70 %) rankings either as I, II. or III choice, which is followed by GPBD-5 (216 ranks,15.52 %) and Dharani (208 ranks, 14.94 %). It may be attributed to, all these genotypes shown comparatively good yield coupled with good tolerance to pests and diseases. Similarly, in rabi/summer, a total of 810 rankings were recorded, among top three varieties preferred by farmers, Kadiri-9 stood first with 18.15 per cent preference (147 ranks), followed by ICGV-00351 (137 ranks, 16.91 %) and GPBD-5 (104 ranks, 12.84 %).

Table.1 List of varieties tested and their important features

Sl. No.	Variety Name	Developed Station	Specific features
1	Kadiri-9	UAS, Raichur/ ARS, Kadiri	High yield (22-25 q/ha), High oil content (48-50%), Drought tolerant, Moderately resistant to foliar diseases
2	ICGV-00351	UAS,Raichur/ ICRISAT/TNAU	High yield (22-27 q/ha), High oil content (48-51%), Drought tolerant, Moderately resistant to foliar diseases
3	Dharani	RARS, Tirupati	High yield, Drought tolerant, tolerant to leaf spots and suitable to rainfed areas.
4	Kadiri Haritandra	ARS, Kadiri	High yield, Drought tolerant, Moderately resistant to foliar diseases
5	TG-37A	BARC, Mumbai	High yield (22-25 q/ha), Bold seeded, Smooth pods, High harvest index
6	TPG-41	BARC, Mumbai	Table purpose, Large seeded, O/L ratio 3.2
7	TG-51	BARC, Mumbai	High yield (25-27 q/ha), oil content (49 %)
8	G_2-52	UAS, Dharwad	Resistant to Late leaf spot and Rust diseases, High yield (25-30 q/ha), Good kernel feature as TMV-2
9	GPBD-5	UAS, Dharwad	Resistant to leaf spots, High yielder (25-30 q/ha), Bold seeded.
10	TMV (Farmers variety)	UAS, Raichur/TNAU	Widely adoptable, Susceptible to pest and diseases and low yielder.

Table.2 List of FPVS trials conducted during *Kharif-2015* and *rabi*/summer-2015-16

Season		*Kharif-2015*		*rabi*/summer- *2015-16*	
Name of Districts	**Name of Locations**	**Mother trail**	**Baby trails**	**Mother trail**	**Baby trails**
Raichur	Devadurga: Sasvigera	1	10	1	10
	Lingasuguru: Golapalli	1	10	1	10
Yadgir	Surapura: Shrinivaspura	1	10	-	-
	Surapura: Gogi tanda	-	-	1	10
Bellary	Bellary: Hagari	1	10	1	10
	Huvinahadagali: Chikkakolachi	1	10	1	10
Koppal	Koppal: Thighari	1	10	1	10
Total		**6**	**60**	**6**	**60**

Table.3 Mean performance of test genotypes for dry pod yield (kg/ha) under FPVS trials at different location during *Kharif* and *rabi*/summer 2015-16

Sl.No.	Name of Genotypes	Season	Golapalli	Srinivasapura	Chikkakolachi	Sasvigera	Thigari	Pooled
1	Kadiri-9	*Kh*-2015	1423	1403	1546	1524	1565	1492
		R/S-2015-16	1713	1536	1647	1507	1673	1588
2	ICGV-00351	*Kh*-2015	1275	1659	1545	1432	1492	1481
		R/S-2015-16	1637	1804	1575	1620	1830	1693
3	Dharani	*Kh*-2015	1299	1167	1388	1384	1414	1330
		R/S-2015-16	1681	1304	1405	1626	1506	1478
4	Kadiri Haritandra	*Kh*-2015	1384	1242	1295	1340	1347	1322
		R/S-2015-16	1405	1434	1411	1347	1671	1454
5	TG-37A	*Kh*-2015	1496	1148	1379	1285	1417	1345
		R/S-2015-16	1575	1380	1525	1644	1595	1550
6	TPG-41	*Kh*-2015	1362	1377	1264	1591	1340	1386
		R/S-2015-16	1550	1565	1437	1568	1401	1504
7	TG-51	*Kh*-2015	1360	1108	1220	1210	1265	1233
		R/S-2015-16	1405	1700	1384	1347	1315	1430
8	G2-52	*Kh*-2015	1195	1232	1629	1379	1416	1370
		R/S-2015-16	1420	1455	1633	1420	1455	1476
9	GPBD-5	*Kh*-2015	1369	1611	1891	1452	1539	1573
		R/S-2015-16	1546	1595	1818	1647	1637	1649
10	TMV-2	*Kh*-2015	1243	1213	1352	1249	1278	1267
		R/S-2015-16	1318	1492	1504	1321	139	1406
	Mean	*Kh*-2015	**1341**	**1316**	**1451**	**1385**	**1407**	**1380**
		R/S-2015-16	**1525**	**1526**	**1534**	**1505**	**1548**	**1523**
	CD (5%)	*Kh*-2015	**324.82**	**357.16**	**177.04**	**396.04**	**275.21**	**150.64**
		R/S-2015-16	**221**	**254**	**249**	**252**	**273**	**179**
	CV (%)	*Kh*-2015	**14.12**	**15.82**	**15.48**	**16.67**	**18.40**	**10.51**
		R/S-2015-16	**13**	**14.7**	**14.8**	**14.8**	**15.3**	**14.2**

Fig.1 Schematic representation of adopted mother-baby trail approach to conduct FPVS experiment

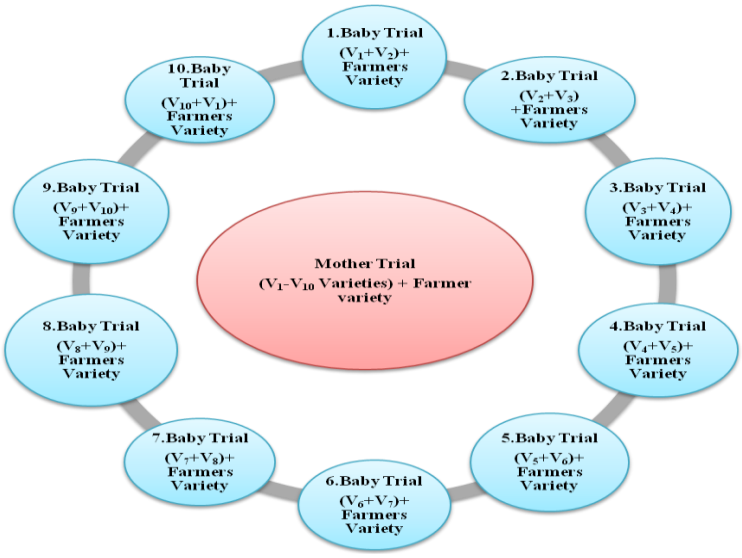

Table.4 Overall Farmer preference of test genotypes during *Kharif* and rabi/summer 2015-16

Sl. No.	Name of Genotypes	Season	Ranking			Total Rankings	Percent preference
			I	II	III		
1	Kadiri-9	*Kh*-2015	188	66	62	316	22.70
		R/S-2015-16	73	45	29	147	18.15
2	ICGV-00351	*Kh*-2015	52	82	28	162	11.64
		R/S-2015-16	76	43	18	137	16.91
3	Dharani	*Kh*-2015	54	60	94	208	14.94
		R/S-2015-16	32	24	26	82	10.12
4	Kadiri Haritandra	*Kh*-2015	10	28	26	64	4.60
		R/S-2015-16	15	27	11	53	6.54
5	TG-37A	*Kh*-2015	18	40	24	82	5.89
		R/S-2015-16	34	42	14	90	11.11
6	TPG-41	*Kh*-2015	10	38	22	70	5.03
		R/S-2015-16	8	15	11	34	4.20
7	TG-51	*Kh*-2015	4	22	14	40	2.87
		R/S-2015-16	2	19	23	44	5.43
8	G_2-52	*Kh*-2015	36	40	40	116	8.33
		R/S-2015-16	20	21	17	58	7.16
9	GPBD-5	*Kh*-2015	72	56	86	216	15.52
		R/S-2015-16	35	23	46	104	12.84
10	TMV-2	*Kh*-2015	28	44	46	118	8.48
		R/S-2015-16	15	13	33	61	7.53
	Total	*Kh*-2015				**1392**	
		R/S-2015-16				**810**	

Table.5 Mean Varietal preference ranking of stakeholders

	Variety									
Trait of variety	K-9	ICGV-00351	Dharani	Kadiri Haritandra	TG-37	TPG-41	TG-51	G_2-52	GPBD-5	TMV-2
Seed size (mm)	2	2	1	2	2	2	1	2	2	2
Seed shape	2	2	1	2	2	2	1	2	2	2
Testa colour	2	2	1	2	2	2	1	2	2	2
Pod size (cm)	2	2	2	2	2	2	2	2	2	2
Pod shape	2	2	1	2	2	2	2	2	2	2
Pod filling	2	2	2	2	2	2	2	2	2	2
Shelling (%)	2	2	2	2	2	2	2	2	2	2
Oil content (%)	3	2	2	2	1	2	1	2	2	2
Market price (Rs)	2	2	2	2	2	2	1	2	2	2
Total rankings	19	18	14	18	17	18	13	18	18	18
Preference rank	**I**	**II**	**IV**	**II**	**III**	**II**	**V**	**II**	**II**	**II**

*Note: 1- Least preferred, 2- Preferred, 3-Most preferred *****Sample size: 50

Similarly Vindhiyaraman *et al.,* (2010) reported ICGV-87846 as most preferred variety by farmers in Tamilnadu, Bucheyeki *et al.,* (2008) found that Johari and Pendo varieties were most preferred by farmers in Nigeria and Dwivedi (2006) reported strong preference of GR-17 rice variety than local genotypes. Ndjeunga *et al.,* (2010) and Monyo (2007) reported that, varieties preferred by farmers are site specific and that variety recommendations should be targeted to specific domains where varieties are preferred by farmers.

The varietal preference of stakeholders were recorded by organizing the on-campus

training programme Stakeholders were asked to rate the varieties from "1" being least preferred to "3" being most preferred. Mean ranking for the important traits (seed size, seed shape, test a colour, pod size, pod shape, pod filling, shelling (%), oil content and market price) are preference ranks are presented in table 5. Results revealed that, mean ranking for most of the traits in each variety recorded preference rank (2). It indicates that, all the test genotypes were having desirable features because most of them were newly developed, high yielding varieties from different research institutes. Based on the total rankings (sum of mean ranking of all the traits) shown that Kadiri-9 scored a total of 19 ranking, which is highest among others, hence it was attributed with overall preference rank of I. Whereas, other genotypes scored total rankings of 18 (ICGV-00351, Kadiri-haritendra, TPG-41, TMV-2, G2-52 and GPBD-5) which were attributed with the overall preference rank of II. However, TG-37A (17), Dharani (14) and TG-51 (13) were least preferred and those were attributed with overall preference rank of III, IV and V respectively. Similarly, ICGV 87846 recorded the most preferred category for all the traits in Tamilnadu (Vindhiyaraman *et al.,* 2010) and ICGV-91114 in Anathpur district of Andhra-Pradesh (Nigam *et al.,* 2005). Tatlonghari *et al.,* (2009) reported that farmers preferred rice varieties with high fertilizer response and submergence tolerance.

By considering the FPVS experimental data as well as preference data from farmer and other stakeholders, it can be revealed that test genotypes Kadiri-9, GPBD-5, ICGV-00351 and Dharani were most preferred cultivars. Based on the results it can be concluded that, farmers participatory varietal selection (FPVS) provide golden opportunity to farmers as it enables them to opt of their choice of varieties under their own conditions, environment and availability of resource. This is consistent with earlier findings (Vindhiyavarman *et al.,* 2010; Adu-Dapaah *et al.,* 2007; Ntare *et al.,* 2007; ICRISAT, 2002–2004; Govindraj *et al.,* 2009; Ndjeunga *et al.,* 2010). It was also observed that farmers were not only looking for yield and also for other desirable traits like disease and pest resistance, drought tolerance, fodder quality and more importantly marketability of varieties, as it illustrated by farmers preference that Kadiri-9 being moderately resistant to diseases, drought tolerant coupled with high yield and GPBD-5 being resistant of foliar diseases ensures high fodder quality with higher yields. Hence farmer's participatory varietal selection (FPVS) opens the avenues for improved varieties to reach farming community, in turn increase in production and productivity of groundnut.

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