

RESEARCH PAPER

ADVANCE RESEARCH JOURNAL OF
C R O P
I M P R O V E M E N T
Volume 8 | Issue 2 | December, 2017 | 172-178
••••• e ISSN-2231-640X

Evaluating of quality of groundnut seeds used for sowing by farmers in Gujarat

DOI:
10.15740/HAS/ARJCI/8.2/172-178
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ABSTRACT : The present study was aimed to evaluate the quality of groundnut seeds used for sowing by farmers of Gujarat. Hundred seed samples of farmers saved seeds of groundnut were collected from 15 farmers of Porbander, 21 farmers of Devbhoomi Dwarka, one farmer of Amreli and 63 farmers of Jamnagar districts of Gujarat. The study revealed that overall 80.00 per cent farmers' saved seed samples of groundnut was confirmed to the required seed standards for germination, moisture content, physical purity and seed health with respect to insect infestation; while, 83.00 per cent seed samples of groundnut had recorded equal or higher than 70 per cent field emergence. These suggested that the quality of groundnut seed used for sowing by farmers was satisfactory in Gujarat. Even though, seed quality was reflected in the yield performance of the crop. Hence, the farmers need to be more educated about the importance and advantages of using good quality seeds and be trained for maintaining the seed quality by adopting pre and post harvest measures so as to harvest good yields of the desired varieties.

KEY WORDS : Groundnut, Seed quality, Germination, Moisture, Physical purity, Field emergence

How to cite this paper : Dhedhi, K.K., Juneja, R.P., Chaudhari, N.N., Sorathiya, J.S. and Khanpara, M.D. (2017). Evaluating of quality of groundnut seeds used for sowing by farmers in Gujarat. *Adv. Res. J. Crop Improv.*, **8** (2) : 172-178, DOI : 10.15740/HAS/ARJCI/8.2/172-178.

Paper History : Received : 27.06.2017; Revised : 28.10.2017; Accepted : 13.11.2017

Groundnut (*Arachis hypogaea* L.) is an annual legume which is also known as peanut, earthnut, monkey-nut and goobers. It is the fourth most important oilseed crop of the world (Radha *et al.*, 2011). Groundnut crop is grown in more than 100 countries in the world. India, China, Nigeria, USA and Indonesia alone contribute to 74% of the total world production. China is the largest producer of groundnut followed by India. India contributes 19% of world production. It occupies an area of 6.41 million ha with a production of 9.82 million tonnes and possesses an average yield of 1.6 tonnes (Begum *et al.*, 2013). Gujarat is one of the largest groundnut producing state of India, with an area of 20 lakh hectare which is mostly grown under *Kharif* season and confined to Saurashtra and Kutch regions. Being a self-pollinated

crop, groundnut seeds can be maintained for several generations without losing its genetic purity. In practice, however, progressive deterioration of original stock occurs through admixture with other varieties and species in cultivars' fields and in the threshing and processing yards. A small percentage of cross-pollination with other varieties cannot be ruled out. Farmers of Gujarat state generally use their own seeds for sowing of groundnut, harvested in the last season, which are stored in gunny bags and kept in common residential room, a traditional method of storage in the region. The groundnut seed are stored mostly in the form of pods and in small amount in kernels. Both are susceptible to attack of insects during storage. The primary damage in stored groundnut is mainly caused by the groundnut seed beetle, *Caryedon serratus*

(Olivier), followed by secondary attack of other insect pests. Presently, *C. serratus* is occurring throughout India causing considerable damage to groundnut at farmers, traders and millers levels. In Gujarat state, this bruchid caused heavy losses upto 84 per cent during storage of groundnut (Anonymous, 1991). In Gujarat, majority of farmers are using thiram, captan or diathan M-45 fungicides as a seed treatment at the time of sowing. Some farmers do not follow proper methods to maintain the purity of the seeds. Deterioration of seed quality takes place due to minor residual segregation, chance mutation, natural cross pollination and variety admixtures (Dahiya *et al.*, 1997). Therefore, a study was made to evaluate the quality of groundnut seeds used for sowing by farmers in Gujarat.

RESEARCH PROCEDURE

One hundred seed samples *viz.*, 15, 21, 1 and 63 samples of different varieties of groundnut were collected from different villages of Porbander, Devbhoomi Dwarka, Amreli and Jamnagar districts of Gujarat, respectively, during 4th June to 1st July, 2016 (Table 1). The number of seed samples comprised of one bunch type (TG-38) and ninety nine semi-spreading (three samples of GJG-22 and 96 samples of GG-20) varieties of groundnut. The collected seed samples of groundnut were first tested for insect infestation (% seed infested) by visual counting and later on for physical purity as per method used by Kant (2001) and moisture and germination percentage according to standard procedures and rules for testing (Anonymous, 2008) at Seed Technology Research Unit, National Seed Project, Pearl millet Research Station, Junagadh Agricultural University, Jamnagar. For evaluating the quality of the farmers' seed samples, germination, moisture content and physical purity percentage were compared with the Indian minimum seed certification standards (IMSCS) of certified seeds as prescribed by Tunwar and Singh (1988). Two hundred seeds were counted from each sample and sown on 25th July, 2016 in field in two rows each of 10 meter and containing 100 seeds with inter and intra row spacing of 60 cm and 10 cm, respectively. The field emergence percentage was recorded by adopting following formula.

$$\text{Field emergence (\%)} = \frac{\text{Number of seedlings emerged}}{\text{Number of seeds sown}} \times 100$$

RESEARCH ANALYSIS AND REASONING

The seed quality parameters of 100 farmers' saved seed samples of groundnut are presented in Table 1. The seed quality status of all the groundnut seeds samples were found good with respect to germination, moisture content, physical purity, insect damage and field emergence percentage during *Kharif* 2016 (Table 1). The maximum germination per cent (97 %) was observed in two samples of GG-20, one from Dudhala village of Devbhoomi Dwarka district and one from Targhadi village of Amreli district. While, germination per cent was to be found the minimum (54.00 %) in two samples, one sample of GG-20 from Dharampur village of Devbhoomi Dwarka district and one sample of GJG-22 from Chavda village of Jamnagar district. Eighty seven farmers' seed samples recorded germination percentage as per prescribed minimum seed certification standard (70 %). The average germination percentage was observed good (80.84 %) in the farmers' saved seed samples studied. This is in line with the findings of Lukose *et al.* (1998); Dhedhi *et al.* (2007); Ghelani *et al.* (2010) and Dhedhi *et al.* (2011 and 2017) who reported that majority farmers' saved groundnut seed samples studied were registered germination percentage upto desired level. Prasad *et al.* (1994) reported that 81 per cent of groundnut seed samples met the minimum requirement of prescribed limit for germination. Rajendra Kumar *et al.* (2005) have also drawn similar conclusion through their study that 99 per cent seed samples of groundnut had germination above prescribed limit. In the present investigation, the minimum percentage of seed moisture content (3.90 %) was exhibited in seven samples, whereas, the maximum percentage of seed moisture content (7.70 %) was found in the seed sample of GG-20 collected from Dharampur village of Devbhoomi Dwarka district. Therefore, 100 per cent seed samples depicted seed moisture percentage less than prescribed maximum seed standards (9.0 %). The average seed moisture percentage was to be found 5.03 per cent. Similarly results were observed in groundnut by Dhedhi *et al.* (2011 and 2017).

The physical seed purity varied from 92.00 to 100 per cent. From all the seed samples studied, 93 samples were conformed to the prescribed minimum seed certification standard for purity (96.00 %), while, seven samples had more than 96 per cent physical seed purity, which was not conformed to the prescribed minimum seed certification standard. Similarly, 93 farmers' seed

Table 1 : The seed quality parameters of farmers saved seeds of groundnut in Gujarat during *Kharif* 2016

Sr. No.	District	Taluka	Village	Name of farmer	Variety	Seed germination (%)	Seed moisture content (%)	Physical purity			Insect damage (%)	Field emergence (%)	
								Pure seed (%)	Inert matter (%)	Other crop seeds (No.)			
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.	Forbander (15)	Porbander (15)	Rojhivada (15)	Narendra N. Nakum	GG 20	62.00	6.50	95.00	5.00	0	0	30.00	57.00
2.				Lalji N. Nakum	GG 20	81.00	6.90	98.00	2.00	0	0	3.00	80.00
3.				Pravinbhai K. Nakum	GG 20	82.00	6.00	98.50	1.50	0	0	1.00	79.00
4.				Jamnaben P. Nakum	GG 20	78.00	5.00	98.00	2.00	0	0	2.00	78.00
5.				Tulsi Karsanbhai	GG 20	89.00	5.50	99.00	1.00	0	0	2.00	88.00
6.				Mansukh Jethabhai	GG 20	81.00	4.10	100	0.00	0	0	0.00	80.00
7.				Vithal Ranchojbhai	GG 20	88.00	4.80	100	0.00	0	0	0.00	85.00
8.				Ramkbbhai R. Nakum	GG 20	87.00	4.80	99.50	0.50	0	0	0.00	84.00
9.				Khima Kana Solanki	GG 20	85.00	4.50	100	0.00	0	0	0.00	81.00
10.				Vajsi P. Singakhiya	GG 20	82.00	4.80	97.50	2.50	0	0	0.00	80.00
11.				Valjibhai P. Nakum	GG 20	89.00	4.90	98.00	2.00	0	0	0.00	87.00
12.				Ladhachai C. Nakum	GG 20	81.00	5.00	99.00	1.00	0	0	0.00	78.00
13.				Jerambhai T. Farmar	GG 20	82.00	4.80	98.00	2.00	2	0	0.00	76.00
14.				Pratulbhai N. Nakum	GG 20	80.00	4.90	99.00	1.00	0	0	0.00	78.00
15.				Babubhai V. Chauhan	GG 20	60.00	6.00	96.00	4.00	1	0	30.00	54.00
16.	Devbhoomi	Khambhalla	Khambhalla	Danjidhai B. Nakum	GG 20	87.00	4.50	98.00	2.00	0	0	0.00	85.00
17.	Dwaraka	Khambhalla	(3)	Jethalal D. Parmar	GG 20	88.00	3.90	99.00	1.00	0	0	0.00	84.00
18.	(21)			Rameshbhai M. Parmar	GG 20	89.00	4.90	100	0.00	0	0	0.00	82.00
19.			Kancorda	Trikam V. Parmar	GG 20	72.00	5.00	96.00	4.00	0	0	0.00	69.00
20.			Shaktinagar	Devjithai G. Nakum	GG 20	84.00	5.40	99.00	1.00	0	0	0.00	80.00
21.			(2)	Sureshbhai V. Parmar	GG 20	73.00	4.90	98.00	2.00	0	0	0.00	65.00
22.			Dharampur	Muliben J. Chopda	GG 20	67.00	5.30	99.00	1.00	0	0	0.00	60.00
23.			(4)	Himatbhai J. Kachatiya	GG 20	75.00	5.10	99.00	1.00	0	0	0.00	71.00
24.				Dharansi J. Chopda	GG 20	54.00	6.90	94.00	6.00	0	0	35.00	51.00
25.				Mohanbhai J. Chopda	GG 20	79.00	7.70	96.00	4.00	0	0	0.00	75.00
26.		Bhanwad	Bhavneshwar	Jeevathai K. Gofad	GG 20	90.00	4.40	97.00	3.00	0	0	0.00	88.00
27.		(11)	(2)	Jeevathai Pababhai	GG 20	91.00	4.90	98.00	2.00	0	0	0.00	91.00
28.			Gadu	Jeevathai P. Karena	GG 20	95.00	4.50	99.00	1.00	0	0	0.00	91.00
29.			(5)	Devabhai Punjabhai	GG 20	94.00	5.00	98.50	1.50	0	0	0.00	92.00
30.				Jerambhai Dudabhai	GG 20	92.00	4.50	97.00	3.00	0	0	0.00	90.00
31.				Palabhai Ajanbhai	GG 20	96.00	4.80	99.00	1.00	0	0	0.00	94.00
32.	Devbhoomi	Bhanwad	Gadu	Ajanbhai Punjabhai	GG 20	92.00	3.90	100	0.00	0	0	0.00	91.00
33.	Dwaraka		Fatehpur	Ramabhai N. Piperotar	GG 20	74.00	5.00	99.00	1.00	0	0	0.00	71.00
34.			(2)	Karsanbhai N. Piperotar	GG 20	87.00	4.40	97.00	3.00	0	0	0.00	87.00
35.			Dudhala	Devsibhai J. Solanki	GG 20	97.00	4.60	98.00	2.00	0	0	0.00	95.00
36.			(2)	Ashokbhai J. Solanki	GG 20	70.00	4.80	99.00	1.00	0	0	0.00	69.00

Table 1 contd. ...

Table 1 contd....

1	2	3	4	5	6	7	8	9	10	11	12	13	14
37.	Amreli (1)	Kunkavav	Targhadi	Babulal D. Khanpara	GG 20	97.00	4.80	59.00	1.00	0	0	0.00	95.00
38.	Jamragar	Jodiya	Lakhtar	Amarsid. Dalsania	GG 20	81.00	5.00	59.00	1.00	0	0	0.00	77.00
39.	(63)	(6)	(4)	Mansukh D. Dalsania	GG 20	75.00	4.50	57.00	3.00	0	0	0.00	77.00
40.				Dharmendra K. Dalsania	GG 20	80.00	3.90	59.00	1.00	0	0	0.00	78.00
41.				Kalubhai K. Boda	GG 20	91.00	4.80	57.00	3.00	0	2	0.00	87.00
42.				Pratubhai D. Godhani	GG 20	65.00	6.80	58.00	2.00	0	1	15.00	64.00
43.				Rameshbhai D. Godhani	GG 20	65.00	6.20	52.00	8.00	2	0	20.00	60.00
44.		Dhrol	Mavapar	Chandrika A. Dalsania	GG 20	84.00	4.40	59.00	1.00	0	0	0.00	80.00
45.		(3)	Motalatala	Rameshbhai A. Bhandari	GG 20	85.00	4.90	59.00	1.00	0	0	0.00	81.00
46.			Vankiya	Bhavesh D. Bhalodia	GG 20	60.00	6.50	100	0.00	0	0	20.00	54.00
47.		Lalpur	NaviPipiar	Pruthviraj A. Chauhan	GG 20	55.00	6.00	54.00	6.00	0	0	40.00	51.00
48.		(9)	(4)	Kanjibhai J. Gohel	GG 20	75.00	4.80	56.50	3.50	0	0	0.00	75.00
49.				Balubhai Vaghji Chauhan	GG 20	81.00	4.90	58.00	2.00	0	0	0.00	85.00
50.				Rameshbhai B. Chauhan	GG 20	75.00	6.50	57.00	3.00	0	0	15.00	70.00
51.				Bharat M. Valodariya	GG 20	88.00	4.90	57.00	3.00	0	0	0.00	84.00
52.				Nandlal D. Valodaria	GG 20	87.00	4.40	59.00	1.00	0	0	0.00	80.00
53.				Bodathai P. Bhawad	GG 20	77.00	4.50	58.00	2.00	0	0	0.00	75.00
54.				Vasantlal J. Ghetia	GG 20	65.00	6.50	57.00	3.00	2	0	5.00	61.00
55.				Kishorebhai J. Ghetia	GG 20	78.00	5.00	59.00	1.00	0	0	0.00	75.00
56.		Kalawad	Machhivad	Baldevsinh D. Jadeja	GG 20	75.00	5.10	58.00	2.00	0	0	2.00	78.00
57.		(12)	(2)	P. D. Jadeja	GG 20	82.00	4.50	56.00	4.00	0	0	0.00	81.00
58.				Rameshbhai D. Ajudia	GG 20	88.00	4.90	59.00	1.00	0	0	0.00	85.00
59.				Pratubhai J. Ramoliya	GG 20	87.00	4.40	100	0.00	0	0	0.00	87.00
60.				Kishorbhai B. Ramoliya	GG 20	78.00	3.90	58.50	1.50	0	0	0.00	75.00
61.				Dhirubhai G. Tada	GG 20	77.00	4.60	59.00	1.00	0	0	0.00	74.00
62.				Hasmukhbhai D. Tada	GG 20	75.00	4.80	59.00	1.00	0	0	0.00	71.00
63.				Ukabhai M. Sorathiya	GG 20	75.00	4.80	100	0.00	0	0	0.00	76.00
64.				Dhirubhai R. Vadi	GG 20	80.00	4.90	100	0.00	0	0	0.00	77.00
65.				Devendrabhai L. Vadi	GG 20	82.00	4.90	100	0.00	0	0	0.00	79.00
66.				Ashokbhai N. Pansuriya	GG 20	81.00	4.80	59.00	1.00	0	0	0.00	78.00
67.				Nitinbhai B. Dhorajia	GG 20	82.00	4.80	59.50	0.50	0	0	0.00	80.00
68.		Jamragar	Vasai	Rajnikant R. Malde	GG 20	90.00	4.90	59.00	1.00	0	0	0.00	88.00
69.		(33)	Shekhpur	Popatbhai L. Kanjaria	GG 20	96.00	4.90	100	0.00	0	0	0.00	93.00
70.			(3)	Mahteshbhai K. Kanjara	GG 20	90.00	5.00	58.50	1.50	0	0	0.00	85.00
71.				Ashokbhai V. Kanjaria	GG 20	78.00	4.50	57.00	3.00	0	0	0.00	75.00

Table 1 contd....

Table 1 contd....

1	2	3	4	5	6	7	8	9	10	11	12	13	14
72.	Jamnagar	Jamnagar	Chavda	Rameshbhai M. Moliya	TG 38	79.00	4.40	97.50	2.50	0	0	0.00	75.00
73.			(9)	Mahipraisinh P. Jaceja	GG 20	70.00	6.00	98.00	2.00	0	0	1.00	66.00
74.				Vallabhbai P. Sanghani	GJG 22	66.00	6.90	95.00	5.00	2	0	5.00	60.00
75.				Ramesh M. Kothiya	GG 20	59.00	6.90	97.00	3.00	0	0	30.10	52.00
76.				Kishorebhai L. Kamani	GJG 22	54.00	6.90	95.50	4.50	0	3	40.10	51.00
77.				Rasikbhai P. Sanghani	GG 20	57.00	6.60	93.00	7.00	1	0	35.10	48.00
78.				Ranjibhai K. Rathod	GG 20	79.00	4.60	99.00	1.00	0	0	0.00	79.00
79.				Maganbhai D. Sanghani	GG 20	85.00	4.80	98.00	2.00	0	0	0.00	85.00
80.				Vanrajsinh T. Chavda	GG 20	84.00	4.80	98.50	1.50	0	0	0.00	83.00
81.			Theba	Harshad V. Sanghani	GG 20	90.00	4.90	99.00	1.00	0	0	0.00	86.00
82.			(3)	Dhaval K. Sanghani	GJG 22	91.00	4.40	96.00	4.00	0	0	0.00	89.00
83.				Sanjay V. Changani	GG 20	94.00	3.90	99.00	1.00	0	0	0.00	93.00
84.			Harshadpur	Kailashbhai K. Vasoya	GG 20	85.00	4.90	97.00	3.00	0	0	0.00	82.00
85.			Chandragadh	Harishbhai J. Sabhaya	GG 20	96.00	3.90	98.00	2.00	0	0	0.00	90.00
86.			Lothiya	Hanrajbhai D. Ranparia	GG 20	85.00	4.60	99.00	1.00	0	0	0.00	80.00
87.			Hadmatiya	Narendrasinh N. Jadeja	GG 20	84.00	4.80	99.00	1.00	0	0	0.00	82.00
88.			(2)	Juvansinh N. Jadeja	GG 20	79.00	4.90	99.00	1.00	0	0	0.00	75.00
89.			Suryapara	Jayeshbhai Gogambhai	GG 20	87.00	4.80	98.00	2.00	0	0	0.00	85.00
90.			(9)	Vijaybhai Gogambhai	GG 20	80.00	4.90	97.00	3.00	0	0	0.00	78.00
91.				Champakbhai Nathabhai	GG 20	87.00	4.90	100	0.00	0	0	0.00	85.00
92.				Nathabhai Bhojabhai	GG 20	89.00	4.40	99.00	1.00	0	0	0.00	84.00
93.				Karsanbhai Ambabhai	GG 20	84.00	3.90	99.00	1.00	0	0	0.00	80.00
94.				Atulbhai Dhanjibhai	GG 20	79.00	4.60	96.00	4.00	0	0	0.00	77.00
95.				Kishorebhai Madhabhai	GG 20	78.00	4.80	97.00	3.00	0	0	0.00	78.00
96.				Shantilal Meghjbhai	GG 20	79.00	4.80	99.00	1.00	0	0	0.00	76.00
97.				Chaganbhai Mavjibhai	GG 20	81.00	4.90	99.00	1.00	0	0	0.00	79.00
98.			Vijaypur	Bhimjibhai K. Dudhagra	GG 20	84.00	4.90	99.00	1.00	0	0	0.00	84.00
99.			(3)	Dineshbhai D. Dudhagra	GG 20	81.00	4.90	98.50	1.50	0	0	0.00	80.00
100.				Jentibhai D. Dudhagra	GG 20	76.00	4.80	99.00	1.00	0	0	0.00	75.00
					--	80.84	5.03	98.10	1.90	0.10	0.06	3.31	77.74
					--	54.30 to	3.90 to	92.00	0.00 to	0.00 to	0.00	0.00 to	48.00 to
						97.00	7.70	100	8.00	2.00	to	40.10	95.00
											3.00		
						70.00	9.00	96.00	4.00	Nil	Nil	--	70.00
						87	100	93	93	94	97	--	83

Indian Minimum Seed Certification Standard (IMSCS) limits

No. of samples conforming to IMSCS

Where: GG= Gujarat Groundnut, GJG= Gujarat Junagadh Groundnut, TG= Trombay Groundnut, Note: Figure in parenthesis indicates number of farmers.

samples manifested inert materials less than prescribed maximum seed standards (4.0 %). The inert matter varied from 0.00 to 8.00 per cent. These results are in agreement with the results reported by Narayanaswamy *et al.* (1996), Dhedhi *et al.* (2011 and 2017) in groundnut for physical purity and inert matters. In the present investigation, number of seeds of other crops varied from 0.00 to 2.00. Among 100 seed samples studied, six had number of seeds of other crops collected two and four samples from Porbander and Jamnagar districts, respectively, as they do not meet the minimum (zero) requirement of seed certification standard. Thereby, 94.00 per cent seed samples of groundnut were to meet the minimum requirement of seed certification standard for other crop seeds. In the present study, the number of weed seeds varied from 0.00 to 3.00. Out of 100 seed samples, three had number of weed seeds (one each from Lakhtar, Keshiya and Chavda villages of Jamnagar district), as they do not meet the minimum (zero) requirement of seed certification standard. Hence, 97.00 per cent seed samples of groundnut were observed free from weed seeds as they conformed to the minimum requirement of seed certification standard. Similar, results were reported by Dhedhi *et al.* (2011 and 2017) in groundnut for other crop seeds and weed seeds.

In the present studied, insect seed damage ranged from 0.00 to 40.00 per cent. Among all the seed samples studied, 81 had free from insect damage and 19 samples showed incidence of groundnut seed beetle [*Caryedon serratus* (Oliver)]. The highest percentage (40.00 %) of insect infestation (*C. serratus* infestation) was recorded in two seed samples (GG-20, GJG-22), one each from Navi pipar and Chavda villages of Jamnagar district, which was manifested the lowest field emergence (51.00 %). Therefore, 19.00 per cent groundnut samples were infested with *C. serratus* and 81.00 per cent were absolutely free from bruchid damage. The average seed damage was observed 3.31 per cent in the farmers' saved seed samples. Ghelani *et al.* (2010) observed that 48.5, 87.9, 63.6 and 87.5 per cent groundnut seed samples were found with infested of *C. serratus* during the year 2006, 2007, 2008 and 2009, respectively. Dhedhi *et al.* (2017) reported that 81.71 per cent seed samples of groundnut were damaged with *C. serratus* during *Kharif* 2015.

The highest percentage of field emergence (95 %) was registered in two seed samples of GG-20, one each from Dudhala village of Devbhoomi Dwarka district and Targhadi village of Amreli district. The lowest percentage

of field emergence (48.00 %) was recorded in GG-20 from Chavda village of Jamnagar district. Among the 100 farmers' seed samples, only 17 samples recorded less than 70 per cent field emergence during the studied. The lower field emergence in these farmers' saved seed may be the result of relatively higher insect damage coupled with poor vigour because most of seed samples had more than the minimum requirement of 70 per cent germination in laboratory during the study. Similar results were reported by Ghelani *et al.* (2010); Dhedhi *et al.* (2011 and 2017) in groundnut.

In Gujarat, majority of farmers use their own saved seeds for sowing of groundnut crop in every year. The present study clearly showed that out of 100 farmers' seed samples, 13 samples for germination, seven for physical purity and inert matter, six for other crops seeds, three for weed seeds and 17 for field emergence were failed to meet the minimum requirement of certified seed standards. Overall, 80 per cent seed samples were conformed to meet the minimum requirement of certified seed standards for germination, seed moisture content, physical purity, inert matter, other crops seeds, weed seeds and field emergence. Thus, the seeds of groundnut used for sowing by farmers of Porbander, Devbhoomi Dwarka, Amreli and Jamnagar districts of Gujarat were of good quality with respect to germination, moisture content, physical purity, seed health (Insect infestation) and field emergence. Even though, seed quality was reflected in the yield performance of the crop. Hence, the farmers of Gujarat state need to be more educated about the importance and advantages of using good quality seeds and be trained for maintaining the seed quality by adopting pre and post harvest measures so as to harvest good yields of the desired varieties.

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