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Effect of different storages on the quality of groundnut of Banda and Jhansi districts of (U.P.) India

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ABSTRACT

Improper storage of oilseeds makes them susceptible to storage fungi, which causes qualitative and quantitative deterioration of the stored oilseeds. These fungi induce numerous biochemical changes affecting the viability of the seeds. In light of this, experiments were conducted to investigate the impact of artificial infestation of storage fungi in various storage conditions on the vigour index, germination percentage, and levels of reducing sugar.

Figure : 00 References : 12 Tables : 06
KEY WORDS : Groundnut, Seed quality, Storage methods.

Introduction

Oilseeds occupy a significant position in the context of both national and global agriculture. They have played a pivotal role in the world economy since ancient times. Oilseeds hold a prominent status among the primary commercial crops of India. Groundnut (*Arachis hypogea*) stands out as one of the most crucial multipurpose oilseeds crops globally[1]. It belongs to the Fabaceae family and also called peanut, is a type of bean that's the third most produced oilseed globally. It's known by different names like monkey nuts, ground nuts, goober peas, earthnuts, and pygmy nuts in various places[2]. India played a significant role in global groundnut (in shell) production during the 2019-20 period, contributing 13.7% of the total global production. This placed India as the second-largest producer after China[4]. In India, groundnut cultivation accounted for 19.1% of the total oilseed cropped area and 21.4% of oilseed production in 2018-19, as reported on the official website of the Ministry of Agriculture and Farmers Welfare, Government of India[6].

Over the years, groundnut production, cultivation area, and yield in India have shown substantial growth. From 1950-51 to 2018-19, groundnut production increased from a mere 3.48 million metric tons to 6.73 million metric tons, the cultivation area expanded from 4.49 million hectares to 4.73 million hectares, and the yield per hectare rose from 775 kg/ha to 1,422 kg/ha. This remarkable progress represents a percentage increase of 93.1% in production, 5.3% in cultivation area, and 83.4% in yield[3, 4].

The world is currently grappling with shortages in edible oils and proteins. The existing average yield of groundnut falls below the required levels. Achieving the anticipated increase in production is possible if adequate attention is given to improved varieties or hybrids, as well as to implementing proper storage systems to naturally safeguard seed efficiency. Oilseeds contain a higher concentration of polyunsaturated fatty acids, making them susceptible to rapid degradation due to lipid oxidation and fungal activity. Loss of viability in oilseed crops can also be attributed to unfavorable storage environmental factors such as high relative humidity and temperature during storage.

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TABLE-1: Fungi associated with seeds of groundnut varieties during storage as identified by Blotter and Agar technique

Variety ↓	Storage	Blotter Technique			Agar Technique	
		Moisture %	Germination %	Infection %	Germination %	Infection %
Chandra	Plastic jar	7.68ab	33.25f	14.65a	34.33h	47.17a
	Polythene bag	7.48abc	50.50de	12.35ab	37.50g	44.50b
	Jute bag	7.95a	58.37bcd	9.97bc	43.83e	38.17d
	Brown paper bag	7.43abc	55.67cd	11.10bc	40.83f	41.17c
Mainpuri	Plastic jar	7.48abc	40.17ef	9.02cd	45.00e	36.83d
	Polythene bag	7.45abc	59.87bcd	8.37cde	47.67d	34.33e
	Jute bag	7.62ab	67.93abc	5.77ef	51.83c	29.50f
	Brown paper bag	7.35bc	66.65abc	6.60def	48.33d	32.33e
Rajasthani	Plastic jar	7.05c	53.03d	6.30def	53.67c	30.17f
	Polythene bag	7.62ab	62.65abcd	5.33ef	56.83b	26.50g
	Jute bag	7.32bc	73.05a	4.15f	62.17a	22.33h
	Brown paper bag	6.98c	68.55ab	4.53f	60.17a	24.33h

*Mean sharing the same letter are not significant according to (DMR) Test. Data are means of six replications

Groundnut seeds can spoil over time because of bugs, rodents, fungi, and other things like going rancid, losing viability, shrinking, or getting lighter. So, to keep them good, groundnut seeds need to be stored carefully[2]. In this context, seed storage is of paramount importance. This paper aims to assess the deterioration in seed quality caused by storage fungi across different storage conditions.

Materials and Methods

Collection of seeds:

Seeds from three groundnut varieties, specifically Chandra, Mainpuri, and Rajasthani, were chosen for this study. These selected seeds were obtained from the Seed Bank of Jhansi and local markets in the Jhansi area.

Seed Storage:

Seeds from all three types of groundnuts were separated and stored in four different storage conditions: plastic jars (PJ), polythene bags (PB), jute bags (JB), and brown paper bags (BPB). These containers were chosen for storage purposes. Over a period of about 18 months, the seeds were stored at room temperature (approximately 27–28°C). At intervals of three months, approximately 200 seeds were taken from each storage type for further research.

The study aimed to assess the effects of storage on various factors, including moisture content, germination percentage, infection rate, root and shoot

TABLE-2 : Number of fungal colonies isolated from storages of groundnut varieties by Blotter and Agar technique

Variety	Storage	Blotter Technique	Agar Technique
Chandra	Plastic jar	656	372
	Polythene bag	535	362
	Jute bag	319	110
	Brown paper bag	292	233
Mainpuri	Plastic jar	408	202
	Polythene bag	545	178
	Jute bag	257	233
	Brown paper bag	419	129
Rajasthani	Plastic jar	452	230
	Polythene bag	455	116
	Jute bag	149	175
	Brown paper bag	275	181

length, seedling vigor index, fungal presence. The experiments were conducted multiple times as needed, following established protocols. The seeds were thoroughly examined using a binocular microscope to identify any presence of mycelium or fruiting bodies on the seed surface. All experiments were carried out under sterile conditions, and proper sterilization of equipment and seeds was performed as required.

Moisture Content:

Moisture content of Groundnut was determined using oven method (BSI, 1980), The moisture content was calculated by using the following formula:

$$\text{Moisture content (\%)} = \frac{M_0 - M_1}{M_0} \times 100$$

[Where M_0 = initial weight (g); M_1= Final weight (g)]

Seed Germination:

The percentage of seed germination was monitored at room temperature on the 3rd, 5th, and 7th days after planting. The room temperature varied between 32°C and 35°C. The germination percentage was computed using a specific formula.

$$\text{Seed Germination (\%)} = \frac{\text{Number of germinating seeds}}{\text{Total number of seeds}} \times 100$$

Seedling Vigour and Vigour Indexes:

Germination of seeds were done following ISTA and observations were recorded at 3rd, 5th and 7th day of plating. Root length and shoot length were separately measured and recorded. Seedling vigour index [SVI] and Vigour index [VI] were calculated by applying the formula:

SVI = Germination percent × (root + shoot length in mm)

VI = Germination percent × root length in cm

The average of each observation was calculated for each variety.

TABLE-3: Frequency of fungal flora isolated from storages of groundnut varieties

S. No.	Fungi	Chandra				Mainpuri				Rajasthani			
		PJ	PB	JB	BPB	PJ	PB	JB	BPB	PJ	PB	JB	BPB
1	*Aspergillus niger*	6.66	10.0	5.00	5.00	8.33	8.33	5.00	6.66	8.33	6.66	6.66	6.66
2	*Aspergillus flavus*	5.00	6.66	3.33	5.00	8.33	8.33	5.00	6.66	5.00	8.33	5.00	3.33
3	*Aspergillus fumigatus*	—	3.33	3.33	5.00	3.33	—	1.66	1.66	—	3.33	—	1.66
4	*Aspergillus terreus*	3.33	5.00	3.33	1.66	3.33	—	1.66	5.00	—	—	—	1.66
5	*Aspergillus parasiticus*	3.33	3.33	1.66	3.33	3.33	5.00	—	3.33	—	5.00	1.66	—
6	*Aspergillus awamori*	1.66	5.00	—	1.66	—	—	—	5.00	3.33	—	—	—
7	*Aspergillus condidus*	—	1.66	—	1.66	1.66	—	—	—	1.66	—	—	—
8	*Aspergillus ochraceus*	—	1.66	—	1.66	—	—	—	1.66	—	—	—	1.66
9	*Alternaria alternata*	3.33	5.00	8.33	5.00	5.00	6.66	3.33	3.33	3.33	6.33	1.66	3.33
10	*Alternaria citri*	5.00	5.00	3.33	3.33	—	3.33	3.33	—	—	1.66	—	—
11	*Absidia corymbifera*	—	—	3.33	—	5.00	—	—	6.66	3.33	—	3.33	—
12	*Cladosporium oxysporum*	—	—	1.66	1.66	1.66	—	—	—	1.66	—	—	—
13	*Cladosporium* sp.	—	1.66	—	—	3.33	—	—	—	5.00	—	—	—
14	*Chaetomium globosum*	1.66	3.33	—	—	—	1.66	—	—	1.66	—	—	—
15	*Chaetomium indicum*	1.66	—	—	—	1.66	—	—	—	—	—	—	1.66
16	*Curvularia* sp.	—	—	—	1.66	—	1.66	—	—	—	1.66	—	—
17	*Diplodia* sp.	1.66	—	—	—	1.66	—	—	—	—	1.66	—	—
18	*Epicoccum* sp.	1.66	—	—	—	—	1.66	—	—	1.66	—	—	—
19	*Fusarium solani*	3.33	—	—	—	6.66	—	—	4.66	—	—	3.33	1.66
20	*Fusarium oxysporum*	5.00	—	—	—	5.00	—	5.00	6.66	1.66	3.33	5.00	—
21	*Fusarium* sp.	1.66	1.66	1.66	3.66	3.33	1.66	1.66	—	1.66	—	—	—

S. No.	Fungi	Chandra				Mainpuri				Rajasthani			
		PJ	PB	JB	BPB	PJ	PB	JB	BPB	PJ	PB	JB	BPB
22	*Helminthosporium* sp.	1.66	—	—	—	—	1.66	—	—	—	1.66	—	—
23	*Macrophomina phaseolina*	—	3.33	—	—	1.66	—	—	—	1.66	—	—	—
24	*Mucor* sp.	3.33	6.66	1.66	1.66	3.33	3.33	1.66	3.33	1.66	5.00	3.33	6.33
25	*Penicillium* sp.	3.33	5.00	—	—	1.66	5.00	—	—	—	1.66	—	—
26	*Penicillium citrinum*	1.66	5.00	—	—	1.66	—	—	—	3.33	—	—	—
27	*Penicillium fumiculosum*	1.66	—	—	—	—	1.66	—	—	5.00	—	—	—
28	*Poecilomyces varietal*	1.66	—	—	—	—	1.66	—	—	1.66	—	—	—
29	*Rhizopus* sp.	5.00	3.33	—	1.66	1.66	3.33	3.33	3.33	3.33	1.66	3.33	3.33
30	*Rhizopus stolonifera*	—	—	5.00	—	—	—	3.33	3.33	—	—	—	5.00
31	*Rhizctonia solani*	3.33	—	—	—	—	—	1.66	—	—	3.33	—	—
32	*Rhizoctonia* sp.	—	—	—	3.33	—	—	—	1.66	—	—	—	1.66
33	*Rhizoctonia bataticola*	—	—	1.66	—	—	3.33	—	—	1.66	—	—	—

Fungi Associated with Seeds in Storage:

Observations were conducted every three months over a span of eighteen months. Approximately 100 seeds were placed in each jar and promptly extracted for assessment. Just as in previous instances, these seeds were positioned on PDA medium and blotter paper. For all PDA procedures, 4-5 replicates were carried out for each storage type and groundnut variety. The growth of colonies was recorded on the seventh day after the initial plating. Based on the preliminary observations, additional fungal isolations were performed. The averages of the principal fungus across the four sets, colony germination percentages, and infection percentages were recorded and preserved.

Frequency of Fungal flora:

On basis of the appearance and identification of fungal colony isolated. Total percentage of fungal incidence was calculated by using the formula.

$$\text{Percentage Frequency} = \frac{\text{Total Number of seeds in which particular fungus appeared}}{\text{Total number of seeds studied}} \times 100$$

Results and Discussion

After a later observation, the moisture content of all three varieties of groundnuts slightly increased at the end of the trial. The Chandra groundnut variety initially had a moisture content of 8%, which decreased to 5.8% in Plastic jar (PJ), 6.0% in Polythene bag (PB), 7.4% in Jute bag (JB), and 6.4% in Brown paper bag (BPB). The moisture content then increased (from 8.8% to 7.9%) until the end of the experiment. Workers[5,10,11] found similar result regarding moisture content. In the Manipuri and Rajasthani groundnut variety, there was a similar pattern of decreasing moisture content followed by an increase. Germination percentages decreased in all storage types and groundnut varieties with the storage period. Groundnut varieties stored in jute bags yielded the best germination results. The germination percentage was recorded as Rajasthani > Mainpuri > Chandra. However, for Chandra, the germination

TABLE-4 : Average root and shoot length of groundnut varieties in different storages

S. No.	Variety	Average of Root Length (cm.)				Average of Shoot Length (cm.)			
		PJ	PB	JB	BPB	PJ	PB	JB	BPB
Autumn 1	Chandra	3.2e	3.4e	3.9f	3.6g	1.9f	2.0g	2.3h	2.1h
	Mainpuri	3.6c	3.8c	4.7b	4.3b	2.6c	2.9c	3.5c	3.2c
	Rajasthani	4.0a	4.3a	4.9a	4.5a	3.0a	3.2a	3.9a	3.6a
Spring 1	Chandra	3.0f	3.2f	3.5h	3.3h	1.5i	1.7i	2.1i	1.8i
	Mainpuri	3.3d	3.5d	4.4d	4.2c	2.4d	2.6d	3.1e	2.9e
	Rajasthani	3.9b	4.2b	4.6c	4.0d	2.7b	3.0b	3.7b	3.3b
Summer 1	Chandra	2.1l	2.3k	2.9j	2.6l	1.2l	1.4l	1.8j	1.6j
	Mainpuri	2.7h	2.8h	3.8g	3.7f	1.7h	1.9h	2.6g	1.8i
	Rajasthani	3.2e	3.4e	4.1e	3.9e	2.0e	2.5e	3.2d	3.0d
Autumn 2	Chandra	1.8n	2.1c	2.7l	2.3n	1.0m	1.2m	1.5l	1.3l
	Mainpuri	1.9m	2.4m	3.5h	3.2i	1.4j	1.6j	2.3h	1.5k
	Rajasthani	2.8g	3.1j	3.9f	3.3h	1.8g	2.3f	2.9f	2.7f
Spring 2	Chandra	2.7h	1.6g	2.4m	2.0o	0.3o	0.8n	1.4m	1.2m
	Mainpuri	1.6o	2.2o	3.1i	2.7k	1.4j	1.5k	2.6g	1.8i
	Rajasthani	2.5i	2.7l	3.5h	3.0j	1.7h	1.9h	2.9f	2.7f
Summer 2	Chandra	2.4j	1.3i	2.2n	1.8p	0.4n	0.5o	1.1n	0.7n
	Mainpuri	1.4p	2.0p	2.8k	2.4m	1.0m	1.2m	2.3h	2.2g
	Rajasthani	2.3k	2.4n	3.1i	2.7k	1.3k	1.5k	1.7k	1.6j

*Mean sharing the same letter are not significant according to (DMR) Test. Data are means of six replications

percentage was notably lower, ranging between 52% and 20% after 20 months of storage. The infection percentage increased with the storage period, rising from 0-30% in the Chandra variety, 0-23% in the Mainpuri variety, and 0-13% in the Rajasthani variety (Table-1).

Using the agar and blotter technique, the fungal

TABLE-5: Seedling vigor index and vigor index of groundnut varieties in different storages

S. No.	Variety	Seedling Vigour Index				Vigour Index			
		PJ	PB	JB	BPB	PJ	PB	JB	BPB
Autumn 1	Chandra	4248	4487	4484	4560	266	282	319.8	288
	Mainpuri	5394	5628	6642	6450	313.2	319.2	380.7	369.8
	Rajasthani	6160	6675	7480	7047	352	382.7	416.5	391.5
Spring 1	Chandra	2529	3224.2	4480	4029	168.6	205.8	280	260.7
	Mainpuri	3249	4270	5850	5914.3	188.1	245	343.2	349.86
	Rajasthani	4527.6	5277.6	6806	6080.9	267.54	307.86	377.2	333.2
Summer 1	Chandra	16.50	2342.1	3525	2982	105	145.59	217.5	184.6
	Mainpuri	2288	3224.2	5542.4	4400	140.4	192.08	329.08	296
	Rajasthani	3463.2	4130	6570	5589	213.12	238	369	315.9
Autumn 2	Chandra	280	1188	1806	1440	18	75.6	116.1	92
	Mainpuri	660	2664	4872	3600.2	38	159.84	294	245.12
	Rajasthani	2944	3704.4	5936.4	4800	179.2	212.66	340.47	264
Spring 2	Chandra	00	720	1489.6	1152	00	48	94.08	72
	Mainpuri	300	1406	2394	1800	16	83.6	130.2	108
	Rajasthani	840	1840	3200	2451	50	108	175	129
Summer 2	Chandra	00	396	1023	700	00	28.6	68.2	50.4
	Mainpuri	264	1120	2244	1702	15.4	70	123.2	88.8
	Rajasthani	396	1365	2112	1591	25.3	84	136.4	99.9

population was regularly monitored in variously stored groundnut varieties every three months [Table-2]. A total of 33 fungus species from 16 genera were identified in different types of stored groundnuts. Among these, *Aspergillus niger, A. flavus, Alternaria alternata*, and *Mucor* sp. were found in all storage types. *A. niger* was the most prevalent species in terms of occurrence. *Rhizopus* was the second-most prevalent, while *Rhizoctonia* sp. and *R. bataticola* were the least prevalent fungi, resulting in *Aspergillus* and *Mucor* species

TABLE-6: Analysis of variance of Seedling vigor index and vigor index of groundnut varieties in different storages by using Anova: Single Factor

ANOVA FOR SEEDLING VIGOR INDEX

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	46945288	3	15648429	3.907993	0.012312*	2.739502
Within Groups	2.72E+08	68	4004211			
Total	3.19E+08	71				

*Significant at P < 0.05

ANOVA FOR VIGOUR INDEX

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	145553.4	3	48517.8	3.766173	0.014573*	2.739502
Within Groups	876011.3	68	12882.52			
Total	1021565	71				

*Significant at P < 0.05

dominating the fungal community (Table-3). Some workers[12], isolated nine species of fungi, from the seeds of different varieties of groundnut during storage of one year. A worker[7], found that the species of *Aspergillus, Penicillium, Fusarium, Rhizopus* and *Alternaria* were commonly occurring post-harvest moods in storage conditions. The predominance *A. flavus* among different species of fungal infection has recently been supported[8].

Seedling vigor index [SVI] and Vigor index [VI] showed a decline over time due to the effects of various storage conditions. However, the average root length of each variety decreased as storage duration increased under each storage type. The average shoot length within varieties did not vary greatly across storage types. Variety Rajasthani exhibited the longest average shoot length across all storage types (Table-4). Previous workers[9], reported that groundnut pods stored in gunny bag recorded maximum infection of *Aspergillus flavus, A. niger, Fusarium* spp. and *Penicillium* spp. which caused reduction in germination and vigour index.

The SVI and VI of these varieties ranged between 4331.6 to 7480 and 266.56 to 416.5, respectively (Table-5). The highest SVI was observed in the Rajasthani variety (7480), followed by Mainpuri (6642), and Chandra (5084). Similarly, the highest VI was found in the Rajasthani variety (416.5), followed by Mainpuri (380.7), and Chandra (319.8). The maximum SVI and VI were observed in the Rajasthani variety stored in jute bags, followed by Mainpuri and Chandra stored in the same type of storage. For the analysis of variance of SVI and VI (Table-6), the null hypothesis is rejected because the p-values are less than 0.05, indicating that there is a significant difference between the groups for both Seedling Vigor Index and Vigour Index. The F-statistic measures the ratio of variance between groups to variance within groups, and the critical F-value is compared to determine statistical significance.

Conclusion

The cultivation and production of groundnut (*Arachis hypogea*) in India hold significant importance both nationally and globally, contributing substantially to the economy and food security. Despite remarkable progress in groundnut production, challenges such as storage-related deterioration in seed quality persist. This study underscores the importance of proper storage conditions in maintaining seed viability and preventing

fungal infestation. The findings highlight the adverse effects of storage fungi on seed germination, vigor, and fungal population dynamics across different storage types. Implementing strategies to improve storage practices and mitigate fungal activity is essential for sustaining groundnut production and ensuring food security amid global shortages in edible oils and proteins.

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