

# Original Research Article

## Screening of Popular Groundnut Varieties Grown in North Gujarat Agroclimatic Zone against *Aspergillusflavus* In Vitro and Pot Condition

### Evaluation of groundnut varieties for resistance to seed infection by *Aspergillusflavus*

**Note 1:** Delete words and sentences in red colour

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#### ABSTRACT

Out of ten varieties tested against *Aspergillus flavus in vitro*, none of the variety was found resistant. The minimum seed infection (20.48%) was recorded in JL501 and KAUSHAL, whereas the maximum (80.46%) in GJG31, maximum seed germination was recorded in variety JL501 (99.99%), whereas the minimum recorded in GJG31(20.48%). The minimum mortality of germinated seeds (10.49%) observed in the varieties GJG9, GJG32, JL501,GG20, GJG22 and KDG128, whereas maximum in GJG31 (30.48%). In pot study, none of the variety was found resistant or moderately resistant. The minimum seed infection (40.47%) was recorded with GJG9, whereas the maximum (70.46%) in GJG31. Maximum seed germination was recorded in variety GJG9 (80.46%), whereas the minimum recorded inGJG31 (23.67%).The minimum seed mortality (10.49%) observed in varieties GJG9, TG37A and KDG128, whereas maximum in GJG31 (30.48%).

*Keywords:*Aspergillusflavus, Groundnut, Screening

#### ABSTRACT

Groundnut is a legume crop an important food crop in the world and the third most important oil seed crop. However, groundnut crop suffers from major diseases such as flavus rot caused by *Aspergillus* which are soil-borne, they produce a potent toxin and carcinogenic substance called aflatoxin. This toxin has a great impact on human health. The resistant varieties can be the most viable and economical approach to reduce this problem.

This research consisted of two experiments, the first was conducted at the (name) Laboratory, while the second pot experiment was conducted in the glass house at the experimental station of the Department of ....., Faculty of ....., at the University of ....., (name country) during name month-name month put year. The objective of the experiment was to evaluation of groundnut varieties for resistance to seed infection by *Aspergillusflavus*. Ten varieties were tested (name of varieties). A (name of design) was used for this experiment, with (number) replications.

Out of ten varieties tested against *Aspergillusflavus in vitro*, none of the varietyieswas found resistant. The minimum seed infection (20.48%) was recorded in JL 501 and KAUSHAL, whereas the maximum (80.46%) in GJG 31, maximum seed germination was recorded in variety JL 501 (99.99%), whereas the minimum recorded in GJG 31(20.48%). The minimum mortalityof germinated seeds (10.49%) was observed in the varieties GJG 9, GJG 32, JL 501, GG 20, GJG 22, and KDG 128, whereas the maximum in GJG 31 (30.48%). In thepot study, none of the varietyieswaswerefound resistant or moderately resistant. The minimum seed infection (40.47%) was recorded with GJG 9, whereas the maximum (70.46%) in GJG 31. Maximum seed germination was recorded in variety GJG 9 (80.46%),

whereas the minimum was recorded in GJG 31 (23.67%). The minimum seed mortality (10.49%) was observed in varieties GJG 9, TG 37A and KDG 128, whereas the maximum in GJG 31 (30.48%).

**Keywords:** *Aspergillus flavus*, Groundnut, Screening

**Keywords:** Groundnut, *Aspergillus flavus*, seed infection, Selected varieties

## 1. INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is an annual legume and also known as a peanut. It is the world's thirteenth most important food crop of the world and third most important oil seed crop used for vegetable oil production. Groundnut is cultivated in the tropical and subtropical regions of the world. India stands first in the area with 4.7 million hectares, second in production (6.7 million ton) and productivity of 1422 kg/ha<sup>-1</sup> (FAO, 2023). In Gujarat, groundnut is grown on about 1688 thousand hectares with a production of 4645 thousand ton and an average productivity of 2751 kg/ha<sup>-1</sup>. In North Gujarat, Banaskantha ranks first in groundnut production (3838 MT) followed by Aravlii (1178 MT) and Kachchh (610 MT) (DOA, 2023). Groundnut seeds (kernels) contain 35.8- 54.2 percent oil (Jambunathan *et al.*, 1985), 16.2-36.0 percent protein (Dwivedi *et al.*, 1990), and 10-20 percent carbohydrate (Salunkhe *et al.*, 1992). Groundnut crop suffers from major diseases such as early leaf spot (*Cercospora arachidicola* Hori), late leaf spot (*Passalora personata* Berk. Curt. N. Arx), rust (*Puccinia arachidis* Speg.), stem rot (*Sclerotium rolfsii* Sacc.), root rot [*Macrophomina phaseolina* (Tassi) Goid.], collar rot (*Aspergillus niger* Van Tieghem), aflatoxin rot (*Aspergillus flavus* Link Ex Fries), nematode disease like root knot and viral diseases like stem necrosis, bud necrosis, mottle and dumble (Ghewande and Reddy, 1986). Among the soil-borne diseases, aflatoxin rot caused by *Aspergillus flavus* is one of the important diseases in the Gujarat region and also in groundnut growing areas of the world (Klich, 2007). *Aspergillus flavus* is a pathogenic fungus in the phylum Ascomycota. *A. flavus* is most common in warm temperate zones and environments with low water levels and higher temperatures. *A. flavus* is found globally as a saprophyte in soils and causes diseases on many important agriculture crops including yellow mold in groundnut in the field, preharvest, postharvest, storage and during transit. *A. flavus* has the potential to infect seedlings by sporulation on injured seeds. They produce a potent toxin and carcinogenic substance called aflatoxin. This toxin has great impact on human health. Therefore this research will look at the evaluation of groundnut varieties for resistance to seed infection by *Aspergillus flavus*.

## 2. MATERIAL AND METHODS

This research consisted of two experiments, the first was conducted at the (name) Laboratory, while the second pot experiment was conducted in the glass house at the experimental station of the Department of ....., Faculty of ....., at the University of ....., (name country) during name month-name month put year. The objective of the experiment was to evaluate groundnut varieties for resistance to seed infection by *Aspergillus flavus*. Ten varieties were tested (name of varieties). A (name of design) was used for this experiment, with (number) replications.

The first experiment in vitro:

### 2.1 Screening in vitro conditions

#### Seed preparation in vitro

Screen ten varieties of groundnut (Table 1) were screened against *A. flavus* (Table 1). Sound, healthy, and mature 100 g kernels/seed of each variety were surface sterilized with 0.1 per cent percent mercuric chloride solution for one minute and washed three times with sterilized distilled water. The seeds of each variety were decanted, and were aseptically placed in sterilized Petri plates/dish. The kernels/seeds were uniformly inoculated with a spore suspension of the seven-days-old culture of *A. flavus* (10<sup>6</sup> spores ml<sup>-1</sup> @ 1 ml per 10 g kernels/seeds), and the seeds were rolled gently for even spread of inoculum. Ten seeds were placed aseptically in each sterile 15 cm diameter Petri plates/dish with three replications and incubated under standard conditions of temperatures and

humidity. After 10 days of incubation, observations were recorded for seed infection, the seed of germination, and mortality of germinated seed.

**Table 1: Varieties of groundnut tested against *A. flavus* *in vitro* and pot conditions**

| Sr.no | Varieties | Sr.no | Varieties |
|-------|-----------|-------|-----------|
| 1     | GJG 9     | 6     | GJG 17    |
| 2     | GJG 32    | 7     | GG 20     |
| 3     | JL 501    | 8     | GJG 22    |
| 4     | TG 37A    | 9     | GJG 31    |
| 5     | KAUSHAL   | 10    | KDG 128   |

The second experiment in the glass house:

## 2.2 Screening in pot conditions

### Seed preparation in pot conditions

Ten groundnut varieties of groundnut (Table 1) were screened against *A. flavus* (Table 1) as the material and method described as above, ten seeds of each variety were sown in sterilized pots filled with sterilized soil, and watering was done regularly in the glass house. After 10 days of inoculation, observations were recorded for seed infection, the seed of germination, and mortality of germinated seed.

The varieties were classified as below (Ghewande et al., 1993).

| Level of resistance  | Criteria  |
|----------------------|---|
| Resistant            | Sporulating growth of <i>A. flavus</i> present on less than 15 per cent percent of seeds; growth and sporulation sparse |
| Moderately resistant | Sporulating growth of <i>A. flavus</i> present on 16 to 30 per cent percent of seeds; sporulating moderate to dense     |
| Susceptible          | Sporulating growth of <i>A. flavus</i> present on 31 to 50 per cent percent of seeds; sporulating dense                 |
| Highly susceptible   | Sporulating growth of <i>A. flavus</i> present on over 50 per cent percent of seeds with dense growth and sporulation   |

## 3. RESULTS AND DISCUSSION

The use of resistant variety can be the most viable and economic approach to reduce *A. flavus* and aflatoxin problem. Hence, this study was undertaken to screen the groundnut varieties of North Gujarat Agroclimatic Zone for resistance to *in vitro* and pot condition seed infection by toxigenic isolates of *A. flavus* (AF-6). The seed infection, seed germination and mortality of germinated seeds are recorded after 10 days of incubation.

### 3.1 Screening *in vitro* conditions

#### The first experiment

#### 3.1.1 Seed infection (%)

Among ten varieties tested, having the seed infection rate ranged from 20.48 to 80.46 per cent percent. The minimum seed infection (20.48%) was recorded with JL501 and KAUSHAL (Table 2), whereas the maximum seed infection (80.46%) was recorded in GJG31. Categorization of different varieties based on seed infection (Table 3) revealed that out of in ten varieties tested, none of the varieties was found resistant against most virulent isolates of *A. flavus* (AF-6).

Two varieties viz., JL501, KAUSHAL were found moderately resistant, whereas three variety viz., GJG9, TG37A and GJG22 were found susceptible, and the remaining five varieties were highly susceptible against to *A. flavus* invasion.

#### 3.1.2 Seed germination (%)

In case of seed germination, 99.99 per cent percent of seed germination was recorded in variety JL501. Which were followed by varieties GJG32 (90.47%), KDG128 (90.47%) and TG37A (87.47%) (Table 2). The minimum seed germination was recorded in variety GJG31 (20.48%).

### 3.1.3 Mortality of germinated seed (%)

Per cent mortality of germinated seed were recorded in the range 10.49 to 30.48 per cent (Table 2). The minimum mortality of germinated seeds (10.49%) was noted in varieties GJG9, GJG32, JL501, GG20, GJG22 and KDG128, whereas the maximum seed mortality was recorded in GJG31 (30.48%).

**Table 2: Seed infection, seed germination, and mortality of germinated seed of different groundnut varieties after 10 days of incubation with *A. flavus* inoculation in vitro conditions**

| Sr. No.    | Name of Varieties | Seed infection (%)              | Seed germination (%)           | Mortality of germinated seed (%) | Level of resistance |
|------------|-------------------|---------------------------------|--------------------------------|----------------------------------|---------------------|
| 1          | GJG9              | 43.35 <sup>b</sup><br>(47.12)   | 51.04 <sup>c</sup><br>(60.46)  | 18.90 <sup>a</sup><br>(10.49)    | S                   |
| 2          | GJG32             | 51.04 <sup>d</sup><br>(60.46)   | 72.02 <sup>b</sup><br>(90.47)  | 18.90 <sup>a</sup><br>(10.49)    | HS                  |
| 3          | JL501             | 26.91 <sup>a</sup><br>(20.48)   | 89.39 <sup>a</sup><br>(99.99)  | 18.90 <sup>a</sup><br>(10.49)    | MR                  |
| 4          | TG37A             | 43.35 <sup>b</sup><br>(47.12)   | 69.27 <sup>b</sup><br>(87.47)  | 21.57 <sup>a</sup><br>(13.52)    | S                   |
| 5          | KAUSHAL           | 26.91 <sup>a</sup><br>(20.48)   | 51.04 <sup>c</sup><br>(60.46)  | 26.91 <sup>b</sup><br>(20.48)    | MR                  |
| 6          | GJG17             | 47.19 <sup>bcd</sup><br>(53.82) | 43.35 <sup>d</sup><br>(47.12)  | 26.91 <sup>b</sup><br>(20.48)    | HS                  |
| 7          | GG20              | 49.12 <sup>cd</sup><br>(57.16)  | 47.19 <sup>cd</sup><br>(53.82) | 18.90 <sup>a</sup><br>(10.49)    | HS                  |
| 8          | GJG22             | 45.27 <sup>bc</sup><br>(50.47)  | 43.35 <sup>d</sup><br>(47.12)  | 18.90 <sup>a</sup><br>(10.49)    | S                   |
| 9          | GJG31             | 63.77 <sup>e</sup><br>(80.46)   | 26.91 <sup>e</sup><br>(20.48)  | 33.51 <sup>c</sup><br>(30.48)    | HS                  |
| 10         | KDG128            | 51.04 <sup>d</sup><br>(60.46)   | 72.02 <sup>b</sup><br>(90.47)  | 18.90 <sup>a</sup><br>(10.49)    | HS                  |
| S.Em. ±    |                   | 1.22                            | 1.37                           | 0.84                             |                     |
| C.D. at 5% |                   | 3.59                            | 4.03                           | 2.49                             |                     |
| C.V.%      |                   | 4.70                            | 4.18                           | 6.58                             |                     |

Figures in parentheses are retransformed values of arc sine transformed values. Treatment means with the letter(s) in common are not significant by DNMRT at 5% level of significance.

#### Level of resistance on the basis of seed infection:

< 15 per cent – Resistant (R), 16-30 per cent – Moderately Resistance (MR), 31- 50 per cent – Susceptible (S), > 51 per cent – Highly Susceptible (HS)

**Table 3: Categorization of different groundnut varieties based on seed infection in vitro condition**

| Sr. No. | Categories                   | No. of varieties | Per cent Varieties | Name of Varieties                    |
|---------|------------------------------|------------------|--------------------|--------------------------------------|
| 1       | Resistant < 15%              | 00               | 0.0                | -                                    |
| 2       | Moderately Resistance 16-30% | 02               | 20.0               | JL501 and KAUSHAL                    |
| 3       | Susceptible 31-50%           | 03               | 30.0               | GJG9, TG37A and GJG22                |
| 4       | Highly Susceptible > 51%     | 05               | 50.0               | GJG32, GJG17, GG20, GJG31 and KDG128 |

## 3.2 Screening in pot conditions

### The second experiment

#### 3.2.1 Seed infection (%)

Among ten varieties tested, having the seed infection ranged from 40.47 to 70.46 per cent percent. The minimum seed infection of 40.47 per cent percent was recorded with GJG9 (Table 4), whereas the maximum seed infection (70.46%) was recorded in GJG31 which was at par with GJG17 (67.21%). Categorization of different varieties based on seed infection (Table 5) revealed that out of ten varieties tested, none of the varieties was found resistant and moderately resistant against most virulent isolates of *A. flavus* (AF-6), whereas six varieties viz., GJG9, GJG32, JL501, KAUSHAL, GJG22, KDG128 were found susceptible and the remaining four varieties were highly susceptible against *A. flavus* invasion.

#### 3.2.2 Seed germination (%)

In case of seed germination, (80.46%) seed germination was recorded in variety GJG9. Which was followed by varieties KDG128 (67.21%), TG37A (63.87%), GG20 (63.87%) and GJG32 (60.46%) (Table 4). The minimum seed germination was recorded in GJG31 (23.67%).

#### 3.2.3 Mortality of germinated seed (%)

Per cent Mortality of germinated seeds were recorded in the range from 10.49 to 30.48 per cent percent (Table 4). The minimum mortality of germinated seeds (10.49%) was noted in varieties GJG9, TG37A and KDG128, whereas the maximum seed mortality was recorded in GJG31 (30.48%).

The present results are new as the latest varieties adopted by farmers of North Gujarat which were not tested earlier. The investigation on seed infection, seed germination, and mortality of germinated seed *in vitro*, pot condition, and field condition done by earlier workers Mixon and Rogers (1973) developed a new *in vitro* seed colonization procedure for screening the groundnut genotypes against *A. flavus*, indicated that valencia type genotypes viz., PI337394F and PI337409 were resistant to two toxin-producing strains of the fungus. Mehan *et al.* (1981) reported that inoculation of seeds of seven groundnut cultivars with three different toxigenic strains of *A. flavus* showed marked differences in invasion potential between cultivars. Among them J-11, PI 337409, and PI 337394 were found to be resistant to invasion and colonization by all three strains and the strain NRRL 3000 was less virulent than the other two on all the cultivars. Mehan *et al.* (1987) used a modified method to screen 850 germplasm accessions for their reaction to seed invasion and colonization by *A. flavus*. Of which, the resistance of the three genotypes viz., PI-337394F, PI-337409, and UF-71513 was confirmed and six new sources of resistance (Ah 7223, J-11, U-4-47-7, var. 27, Faizpur and Monir 240-30) were identified. Mehan *et al.* (1988) evaluated the 11 peanut genotypes by IVSCAF and showed that six were resistant and five susceptible, further evaluated under field conditions in seven environments in South India and found that five of the IVSCAF resistant genotypes had significantly greater resistance to infection of seed by *A. flavus* and had lower aflatoxin contamination than the susceptible genotypes.

Kiran *et al.* (1988) evaluated 53 groundnut cultivars and found that, high-yielding lines were susceptible to invasion by *A. flavus* and aflatoxin contamination and indicated that, line Oh 53-1 showed the highest resistance with low yield potential and J-11 showed resistance to aflatoxin production and moderately susceptible reaction to *A. flavus* invasion. Mehan *et al.* (1991) screened out the 34 genotypes and reported varied levels of seed colonization severity (1.0 to 4.0) on different genotypes viz., ICG-1126, 1323, 1122, 1859, 3263, 3267, 3336, 3700, 4749, 4888, 7412, 7633, 9610, 10020. Collison *et al.* (1992) examined four groundnut genotypes for mold flora and reported that the degree of contamination ranged from 68 to 76 per cent percent, with *A. flavus* as the predominant mold on groundnut.

Waliyaret *al.* (1994) tested 25 lines, including germplasm, advanced breeding lines, and cultivars found that out of these, cultivars 55-437, J11, and PI 337394 F were the least infected, whereas among the ICRISAT advanced breeding lines involving parents resistant to *A. flavus*, ICGV 87084, ICGV 87094, and ICGV 87110 were resistant. Rao *et al.* (1995) assessed the Spanish groundnut germplasms ICGV-88145 and ICGV-89104 for seed colonization by *A. flavus* under artificial inoculation conditions and it averaged 22.2 and 24.0 per cent percent compared with 15.6 per cent percent in the best resistant control (J-11).

Upadhyay *et al.* (2001) have released three lines *viz.*, ICGVs 91278, 91283, and 91284 as improved germplasm for resistance to natural seed infection and *in vitro* seed colonization by the aflatoxin-producing fungus *Aspergillus flavus* in groundnut and they also found J-11 as resistant and JL-24 as susceptible varieties. Varma *et al.* (2001) evaluated 14 different groundnut cultivars for resistance to *in vitro* seed colonization with toxigenic strains of *A. flavus*. Among them, three genotypes S 206, KRG 1, and GPBD 4 recorded relatively low levels of colonization, whereas cultivars JL-24, TAG-24, and TMV-2 were reported as susceptible.

Gowda *et al.* (2002) studied mutant 28-2 a bold seeded groundnut genotype for disease resistance and noted **that** colonization severity of 3.0 for *A. flavus* compared to 3.7 for JL-24 on a 1-4 scale. Babu *et al.* (2004) reported that ICGV 86155, ICGV 86699 and ICGV 96266 were significantly more resistant to *A. flavus* compared to resistance check J-11.

Babuet *et al.* (2005) reported that Trombay groundnut genotypes TG-19, TG-49, TG-18A, and TG-18 showed a high level of resistance **with** very low seed colonization by *A. flavus* compared to resistant check J-11.

Kumar (2005) evaluated fifteen genotypes **in** the laboratory for seed coat resistance against *A. flavus* **and** reported Dh-86 as moderately resistant, three as susceptible (GPBD-4, Dh-102 and R-8808), 11 as highly susceptible (TGLPS-3, TKG-19A, R-9251, Dh-40, J-11, JL-24, ICGV- 92242, TAG-24, Dh-3-30, Dh-54, TMV-2) and none of the genotype was found resistant. Waliyaret *et al.* (2006)

evaluated 14 new varieties for *in vitro* seed colonization with *A. flavus* **and** reported that new varieties (ICGV 91278, 91279, 91283, 91284, 91315, 91317, 91324, 91328, 91341, 92302, 93305, 93328, 93379 and 94434) consistently showed < 10 **per cent** seed colonization as compared with susceptible variety TMV-2 (> 50-90 **per cent** seed colonization). Dube and Maphosa (2014) tested 11 genotypes for seed resistance status only three genotypes (Falcon, CG 7 and Nyanda) were found to be moderately resistant to infection by

*A. flavus* and the remaining eight genotypes (Makulu Red, Tern, Teal, Mwenjere, SC Orion, Flamingo and SC GV 00004) were susceptible in the laboratory tests. Ranganathswamy *et al.* (2017) carried out *in vitro* study to identify a resistant source against *A. flavus* causing aflatoxin contamination in groundnut by spore spray method and among 70 genotypes tested 7 were moderately resistant, 21 were susceptible and 42 were highly susceptible in spore spray method. Commey *et al.* (2021) investigate the role of seed coat against *A. flavus* infection. *In vitro* seed colonization with and without seed coat showed that the seed coat acts as a physical barrier, and the developmental series of peanut seed coat showed the formation of a robust multilayered protective seed coat. Radial growth bioassay revealed that both insoluble and soluble seed coat extracts from 55-437 line (resistant) showed higher *A. flavus* inhibition compared to **the** TMV-2 line (susceptible). Nakrani and Sevak (2021) screened the twenty varieties of groundnut for *A. flavus* invasion and aflatoxin production by dry seed resistance test, among them none of the variety **ies** was found immune as well as resistant against most virulent isolates. **Further more** TMV-2 showed maximum seed infection (83.33%), TMV-7 showed **cent per cent** seed germination while the maximum seed mortality was recorded in ICGV- 89280 (73.89%), whereas minimum seed infection (16.67%) and mortality of germinated seeds (10.74%) in the J-11.

Salunke *et al.* (2021) conducted a screening trial of groundnut genotypes for resistance to *in vitro* seed colonization and infection by *A. flavus*, **comprised** **comprising** 9 local cultivars of Karnataka, 34 germplasm collections and 25 advanced breeding lines from ICRISAT along with popular tolerant variety J-11 used as check and the results showed that ICGV-02207 and ICGV-02266 exhibited both seed coat and cotyledon resistance. **From** **T**ime to time after development of different genotypes, cultivars, varieties *etc.* and found the different levels of resistant which **is** **are** important tools in breeding works and also helpful to the farmers to grow resistant variety **ies** against *A. flavus* and that **'s** **is** a way aflatoxin reduction which was hurdles for groundnut export.

**Table 4: Seed infection, seed germination and mortality of germinated Seed of different groundnut varieties after 10 days of incubation inoculation with *A. flavus* in pot conditions**

| Sr. No.    | Name of Varieties | Seed infection (%)             | Seed germination (%)           | Mortality of germinated seed (%) | Level of resistance |
|------------|-------------------|--------------------------------|--------------------------------|----------------------------------|---------------------|
| 1          | GJG9              | 39.51 <sup>a</sup><br>(40.47)  | 63.77 <sup>a</sup><br>(80.46)  | 18.90 <sup>a</sup><br>(10.49)    | <b>S</b>            |
| 2          | GJG32             | 45.27 <sup>bc</sup><br>(50.47) | 51.04 <sup>b</sup><br>(60.46)  | 24.24 <sup>b</sup><br>(16.86)    | <b>S</b>            |
| 3          | JL501             | 41.43 <sup>ab</sup><br>(43.78) | 45.27 <sup>c</sup><br>(50.47)  | 26.91 <sup>bc</sup><br>(20.48)   | <b>S</b>            |
| 4          | TG37A             | 47.19 <sup>c</sup><br>(53.82)  | 53.05 <sup>b</sup><br>(63.87)  | 18.90 <sup>a</sup><br>(10.49)    | <b>HS</b>           |
| 5          | KAUSHAL           | 41.43 <sup>ab</sup><br>(43.78) | 45.27 <sup>c</sup><br>(50.47)  | 26.91 <sup>bc</sup><br>(20.48)   | <b>S</b>            |
| 6          | GJG17             | 55.07 <sup>d</sup><br>(67.21)  | 41.43 <sup>cd</sup><br>(43.78) | 31.31 <sup>cd</sup><br>(27.01)   | <b>HS</b>           |
| 7          | GG20              | 47.19 <sup>c</sup><br>(53.82)  | 53.05 <sup>b</sup><br>(63.87)  | 24.24 <sup>b</sup><br>(16.86)    | <b>HS</b>           |
| 8          | GJG22             | 45.27 <sup>bc</sup><br>(50.47) | 37.51 <sup>d</sup><br>(37.07)  | 29.11 <sup>bcd</sup><br>(23.67)  | <b>S</b>            |
| 9          | GJG31             | 57.08 <sup>d</sup><br>(70.46)  | 29.11 <sup>e</sup><br>(23.67)  | 33.51 <sup>d</sup><br>(30.48)    | <b>HS</b>           |
| 10         | KDG128            | 45.27 <sup>bc</sup><br>(50.47) | 55.07 <sup>b</sup><br>(67.21)  | 18.90 <sup>a</sup><br>(10.49)    | <b>S</b>            |
| S.Em. ±    |                   | 1.37                           | 1.57                           | 1.55                             |                     |
| C.D. at 5% |                   | 4.05                           | 4.63                           | 4.56                             |                     |
| C.V.%      |                   | 5.11                           | 5.73                           | 10.59                            |                     |

Figures in parentheses are retransformed values of arc sine transformed values.

Treatment means with the letter(s) in common are not significant by DNMR at 5% level of significance.

**Level of resistance on the basis of based on seed infection:**

< 15 per cent – Resistant (R), 16-30 per cent – Moderately Resistance (MR), 31- 50 per cent – Susceptible (S), > 51 per cent – Highly Susceptible (HS)

**Table 5: Categorization of different groundnut varieties based on seed infection in pot conditions**

| Sr. No. | Categories                   | No. of varieties | Per cent Varieties | Name of Varieties                             |
|---------|------------------------------|------------------|--------------------|---|
| 1       | Resistant < 15%              | 00               | 0.0                | -   |
| 2       | Moderately Resistance 16-30% | 00               | 0.0                | -   |
| 3       | Susceptible 31-50%           | 06               | 60.0               | GJG9, GJG32, JL501, KAUSHAL, GJG22 and KDG128 |
| 4       | Highly Susceptible > 51%     | 04               | 40.0               | TG37A, GJG17, GG20 and GJG31                  |

**CONFLICT OF INTEREST:** None

Where is the conclusion and recommendations?

There should be a conclusion and recommendations.

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