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Study on screening of different genotypes of chickpea against *Callosobruchus Chinensis* (L)

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Abstract
Chickpeas (*Cicerarietinum L.*) are one of the oldest and most widely consumed legumes in the world, particularly in tropical and subtropical areas. This study was conducted at Breeding farm of AICRP chickpea JNKVV Jabalpur, the study was done by two experiments, first is to provide the free condition for *Callosobruchus chinensis* so that they prefer the host of their own choice and then in next phase forced condition for the newly emerged beetles so that they should be forced for their development according to host choosen by us. Then in the next experiment germination test is done to check the germination percentage of infested grains of chickpea. The outcome of experiments was found under unforced condition among 15 different genotypes of desi chickpea eggs emergence was highest on JGG 2 (207.67) and lowest on JG14 x IPC 4958 (64.67) and then emergence of adults is highest from JG 24 (90.67) and lowest from JG 32 (30.00), same under forced condition among 15 genotypes of kabuli chickpea eggs emergence was highest on JGK 17 (199.00) and lowest on JGK 1 x JGK 2 (99.33) and then emergence of adults is highest from JGK 5 (80.67) and lowest from JGK 1 x JGK 2 (49.33) and germination percentage for desi chickpea after 15 days of germination period was highest in DRRJ 2 x KAK 2 (61.00%) and lowest in JG 9605 (10.00%) and germination percentage for kabuli chickpea after after 15 days of germination period was highest in JGK 1 x JGK 2 (66%) and lowest in ICARDA 28118 x 09 (36.00%)

Keywords: Study, screening, different genotypes, chickpea against *Callosobruchus chinensis* (L)

Introduction
Chickpeas (*Cicerarietinum L.*) are one of the oldest and most widely consumed legumes in the world, particularly in tropical and subtropical areas. It is also called as Ceci bean, Bengal gram, Garbanzo bean, Chana and Sanagalu bean. Chickpea is a versatile crop that is grown in almost every part of globe today. Some of the major producers of *desi* chickpea are India, Pakistan, Myanmar, Australia and Bangladesh, while the top producers of Kabuli chickpeas are Turkey, Iran, Spain, Canada, Syria, USA, Ethiopia, Tanzanzia, Tunisia, Sudan, Malawi and Portugal. India is the largest producer of chickpea followed by Pakistan, Turkey and Iran. In fact, about 70% of total world production of chickpeas is dominated by India. (Anonymous, 2012) [7]. India occupies first position in the world in terms of area (66%) and production (70%). The crop occupies 9.01 million hectare area with production of 7.58 million tonnes and 911 kg/ha productivity. In Madhya Pradesh chickpea is cultivated in 3.04 million hectare with an annual production of 3.29 million tonnes and productivity of 1082 kg/ha (FAOSTAT 2012). It is primarily grown in Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh, Andhra Pradesh and Karnataka, but on small scale in Orissa, Bihar, Gujrat, Tamilnadu and Haryana also (Anonymous 12-13).

Abiotic and Biotic stresses are the major constraints in enhancing the productivity of chickpea in India. Insect – pests and diseases are biotic bottlenecks in realizing its potential yield. To keep pace with the demand of ever increasing human population of the country, there is an urgent need to increase the production of chickpea. One of the most practical means of increasing chickpea production is to minimize losses caused by the biotic factors, which include insect-pests, diseases and weeds under field conditions. Chickpea faces the attack of more than 60 insect-pets right from germination to maturity and also in storage (Srivastava *et al*, 2005).

Looking to the area and productivity ratio and post-harvest maintenance of produce, it is very clearly evident that pulse beetle Callosobruchus spp. responsible for limiting the stock of

pulses specially chickpea. Pulse beetle *Callosobruchus chinensis* (Coleoptera: Bruchidae), commonly known as "Dhora or Ghun" is an important storage pest of pulses (Gram) in India. It causes (5-10%) damage in temperate region and (20-30%) damage in tropical region (Nakakita 1995). Its life cycle completes in 25-35 days in summer and 45-55 days in winter. It is reported that 55-60% loss occurs in seed weight and 45.5-66.3% in protein (Ghosh and Durbey 2003)

In present time to avoid the damage and yield losses various synthetic insecticides and fumigants and their indiscriminant use in field and storage, cause insect resistance in insect and residual effects in grains while consumption as food and give rise to various serious diseases in the human body, therefore after recording the several plants habits like malic acid content in leaves of chickpea, foliage colour, seed surface, seed colour, seed size has been affecting the incidence level of pest (Sarwar *et al*, 2011) [41]. However, such high quantum in yield losses can be lowered by the adoption of improved technologies for its cultivation, which include the sowing of pest resistant/tolerant variety at optimum time supported with recommended agronomic manipulation. It is considered as simple, easy, cheap and ideal method of combating pest problems from farmer point of view, this can be most acceptable from pest control technique. Therefore this aspect is also included in the present study of screening of different genotypes of chickpea against *Callosobruchus chinensis* (L) in storage.

Material and Methods

For conducting experiments on above investigation following materials were required.

Insect culture

For maintenance of the culture of C.chinensis (L.) on the chickpea local variety 1 kg fresh seeds were kept in glass trough (10cm×25cm) and 100 pairs of freshly emerged beetles were released on seeds. The trough was covered by muslin cloth tied with rubber bands and kept in incubator at 28± 1 ℃. Fresh culture was maintained constantly from the newly emerged beetles. Aspirator was used for transforming and handling of the beetles to avoid injury to them. Freshly emerged beetles of 24 hours old were used for the experiments.

Male and female beetles were identified on the basis of the strongly unipectinated antennae in males, and slightly serrated antennae and longer broad abdomen in females.

The moisture percentage in the grain at the time of treatment was determined in the seed testing laboratory of Department of Plant Breeding and Genetics, JNKVV, Jabalpur by using Oswan Universal Moisture meter based on electrical conductor.

The average moisture percentages of seeds during the course of experiment were conducted with 30 genotypes having in seed size, colour, and texture of seed test.

During present investigation, following experiments were conducted. [1] For preference and non-preference. And [2] For germination test.

Experiment No. 1: For preference and non-preference.

(A) Under free choice condition:

For ovipositional preference, 10 g seeds each cultivar were kept in open petridishes (4.5cm size) and then these were randomly arranged in metal trough (50×10cm size). Thirty pairs of newly emerged adult beetles were released in the center of the trough and was then covered with muslin cloth and tied with thread. The experiment was replicated three times in 48 hours interval.

The beetles in each cultivar were removed from the petri dishes after their death of all adult beetles. The egg laid on each cultivar were counted to see ovipositional preference, each cultivar was kept in separate plastic jars. Then each jar was covered with muslin cloth and tied with rubber bands. Observations were taken in 48 hours interval by counting number of adult beetle emerged. The survival percentage in each genotype was also worked out on the basis of eggs laid and numbers of adult emerged, in each cultivar. The percent seed weight lost was also recorded. The data obtained was statistically analyzed for analysis of variance.

(B) Under force condition

To study the effect of genotype on the life cycle of the pulse beetle particularly on total number of eggs laid, total numbers adult beetles emerged and survival percentage. 50 g seeds of each genotype were kept in separate plastic jars and then ten pairs of freshly emerged beetles were released in each plastic jar and the forced condition were provided to beetles to lay eggs. All the beetles were removed from the separate jar after death. The experiment was replicated three times in 48 hours interval. Number of eggs laid in each cultivar were counted and one week after death of all adults daily observation was taken by counting number of adults emerged. The survival percentage was also recorded. The data was subjected to $\sqrt{n+0.5}$ or angular transformation, as the cause may be, for statistical analysis.

Experiment No.2: For germination test

50 grams of healthy infestation free chickpea seeds from each cultivar were kept for two months with bruchids and without bruchids separately in storage at normal room temperature. After two months, grading will be done on the basis of hole occur on the seeds and without hole separately, and percentage germination and viability of seeds for each sets were tested. Equal no. of seeds were soaked in water for 24 hours in plastic cups, then wrapped in paper towels and kept for overnight. Observation on germination and normal growth was recorded on first, second, third and fourth days after germination.

Results

Experiment No.1 A: Free choice (Preference)

1 B: Forced condition (No Preference)

Under free choice condition in Deshi genotypes

In this experiment, free choice was given to adult beetles for egg laying and ovipositional preference was observed on deshi genotypes. Observations on number of eggs laid, per cent of adults emerged, per cent seed weight loss were recorded and presented in table.

Ovipositional behavior of *C. chinensis*

According to table, data on number of eggs laid on different genotype was statistically analyzed and there was significant difference between numbers of eggs laid on different chickpea genotype at 5% level of probability. The data revealed that cultivar namely JGG 2, was found to be the most preferred host for oviposition with an average of 207.67 eggs which were significantly higher than the average number of eggs laid on any other genotypes. The second group in descending order of preference included ICCV 07117, JG 14-11, JG 24,

and JG 14-16 X JG 11 with an average of 194.33, 192.33, 177.63, and 174.00 eggs respectively.
These four genotypes were at par with each other, but significantly most preferred for oviposition than the rest of the genotypes except JGG 2 which rank first. These four genotypes were followed by JG 30 (162.67), JG 9605 (155.33) which ranked third in order of preference.
Genotypes viz. JG 31 (134.00) and JG 14-16 (131.00) were at par and significantly more preffered than DRRJ 2 × KAK 2 (127.33) and JG 32 (117.67). These two genotypes were also at par. Genotypes JG 14× IPC 4958 (64.67), JG 130 × ICC 11551 (82.00) was found least preferred host for oviposition, followed by JG 74 × IPC 4958 (82.33) and JG 14 (84.64).

Per cent Adult emergence
The genotype JG 24 (90.67) was found significantly best host seed for the development of bruchids than all other genotypes. The genotypes JG 14-11 (81.00), JGG 2 (79.33), ICCV 07117 (72.33), JG 30 (71.33), DRRJ 2 x KAK 2 (60.67), JG 74 x IPC 4958 (59.67) were statistically found at par with each other. JG 14-16 x JG 11, JG 14-16, JG 14 and JG 9605 are the genotypes more or less preferred host. The genotype which found significantly less preferred host for development of bruchids is JG 32 (30.00) followed by JG 130 x ICC 11551 (31.67), JG 31 (33.00), JG 14 x IPC 4958 (33.33) were found at par with each other.

Per cent Male and Female adult emergence
The genotype JG 24 (90.67) was found significantly best host seed for the development of bruchids than all other genotypes and the genotype which found significantly less preferred host for development of bruchids is JG 32 (30.00). Male and female emergence per cent in best host seed JG 24 is (52.95) and (47.05) respectively, while for most less preferred host seed JG 32 male and female emergence percent is (58.04) and (42.97) respectively.

Per cent seed weight loss after 3 months
The difference in per cent weight loss due to feeding of pulse beetle, among different chickpea genotype were found to be significant at 5% level of probability. Due to feeding of pulse beetle on different chickpea genotypes, the significantly more weight loss percentage was found in JG 14 X IPC 4958 (93.29) followed by JG 14 (86.44), JG 24 (85.48), DRRJ 2 X KAK 2 (70.47) and these genotypes were found at par with each other except JG 30 (53.94), which was at par with JG 14-16 (49.34), JG 14-11 (49.32). The genotypes JG 14-16 x JG 11, JGG 2, JG 130 x ICC 11551 were also found at par with an average of (31.72), (28.79), (25.01), respectively and only JG 31 (23.45), ICCV 07117 (21.02), was also found at par with each other. Significantly less per cent weight loss was observed in genotype JG 32 (15.85).

Under free choice condition in Kabuli genotypes
In this experiment, free choice was given to adult beetles for egg laying and ovipositional preference was observed on kabuli genotypes. Observations on number of eggs laid, per cent of adults emerged, percent seed weight loss were recorded and presented in table.

Ovipositional behavior of *C.chinensis*
According to table, data on number of eggs laid on different genotype was statistically analyzed and there was significant difference between numbers of eggs laid on different chickpea genotype at 5% level of probability. The data revealed that cultivar namely JGK 17, was found to be the most preferred host for oviposition with an average of 199.00 eggs which were significantly higher than the average number of eggs laid on any other genotypes. The second group in descending order of preference included FLIP 01-29 C, JGK1, JGK 1 x JGK 4 and JGK 19 with an average of 198.67, 195.67, 194.67 and 184.33 eggs respectively.
These four genotypes were at par with each other, but significantly most preferred for oviposition than the rest of the genotypes except JGG 2 which rank first. These four genotypes were followed by ICARDA 16102 x 07 (183.33), ICARDA 28118 x 09 (180.00) which ranked third in order of preference.
Genotypes viz. JGK 22 (178.67) and ICARDA 16113 x 07 (176.00) were at par and significantly more preferred than JGK 5 (163.33) and SUBHRA (156.67). These two genotype were also at par. Genotypes JGK 1 x JGK 2 (99.33), JGK 25 (102.00) was found least preferred host for oviposition, followed by JGK 24 (119.33) and JGK 13 (150.33).

Per cent adult emergence
The genotype JGK 5 (80.67) was found significantly best host seed for the development of bruchids than all other genotypes. The genotypes JGK 19 (77.00), JGK 17 (74.00), FLIP 01-29C (72.00), JGK 13 (71.67), ICARDA 28118 x 09 (70.00), JGK 24 (69.67) and JGK 22 (66.00) were statistically found at par with each other. ICARDA 16113 x 07, JGK 1 and SUBHRA are the genotypes more or less preferred host. The genotype which found significantly less preferred host for development of bruchids is JGK 1 x JGK 2 (49.33) followed by JGK 1 x JGK 4 (52.67), JGK 25 (56.00), ICARDA 16102 x 07 (58.00) were found at par with each other.

Per cent Male and Female adult emergence
The genotype JGK 5 (80.67) was found significantly best host seed for the development of bruchids than all other genotypes and the genotype which found significantly less preferred host for development of bruchids is JGK 1 x JGK 2 (49.33). Male and female emergence per cent in best host seed JGK 5 is (48.98) and (51.02) respectively, while for most less preferred host seed JGK 1 x JGK 2 male and female emergence percent is (50.53) and (49.47) respectively.

Per cent seed weight loss after 3 months
The difference in per cent weight loss due to feeding of pulse beetle, among different chickpea genotype were found to be significant at 5% level of probability. Due to feeding of pulse beetle on different chickpea genotypes, the significantly more weight loss percentage was found in JGK 24 (50.05) followed by JGK5 (35.25), JG 19 (31.14), SUBHRA (29.67), JGK 25 (29.34) and ICARDA 16102 x 07 (28.79) these genotypes were found at par with each other except JGK 13 (27.66), which was at par with FLIP 01-29 C (26.00), JGK 1 (24.49). The genotypes JGK 22, JGK 17, ICARDA 28118 x 09, ICARDA 16113 x 07 and JGK 1 x JGK 4 were also found at par with an average of (21.71), (20.49), (20.49), (18.65) and (14.08) respectively. Significantly less per cent weight loss was observed in genotype JGK 1 x JGK 2 (10.74).

Under forced condition in Deshi genotypes
In this experiment, pulse beetle were forced to feed on all 15 deshi genotypes. Observations on number of eggs laid, percent adult emerged, percent male and female emerged and percent seed weight loss were recorded and presented in table.

Ovipositional behavior of *C.chinensis*

According to table, data on number of eggs laid on different genotype was statistically analyzed and there was significant difference between number of eggs laid on different chickpea genotype at 5% level of probability. The data revealed that cultivar namely JG 14, was found to be the most preferred host for oviposition with an average of 685.00 eggs which were significantly higher than the average number of eggs laid on any other genotypes. The second group in descending order of preference included JG 9605, JG 30, JG 14-11, and JG 14 x IPC 4958 with an average of 477.67, 471.33, 470.00, and 454.33 eggs respectively.

These four genotypes were at par with each other, but significantly most preferred for oviposition than the rest of the genotypes except JG 14 which rank first. These four genotypes were followed by JG 14-16 (443.67), ICCV 07117 (427.00) which ranked third in order of preference.

Genotypes viz. JGG 2 (419.33) and JG 24 (413.00) were at par and significantly more preferred than JG 130 x ICC 11551 (406.00) and JG 14-16 x JG 11 (391.67). These two genotypes were also at par. Genotypes DRRJ 2 x KAK 2 (319.67), JG 31 (331.67), was found least preferred host for oviposition, followed by JG 32 (357.67) and JG 74 x IPC 4958 (365.67).

Per cent Adult emergence

The genotype JG 9605 (121.33) was found significantly best host seed for the development of bruchids than all other genotypes. The genotypes JG 30 (101.00), JG 130 x ICC 11551 (99.33), ICCV 07117 (80.67), JG 14-16 (79.33), JG 14 (72.33), JG 14-11 (72.00) were statistically found at par with each other. JG 32, JG 31, JGG 2 and JG 14-16 X JG 11 are the genotypes more or less preferred host for development of bruchids. The genotype which found significantly less preferred host for development of bruchids is DRRJ 2 x KAK 2 (59.33) followed by JG 24 (62.00), JG 14 x IPC 4958 (63.33), JG 74 x IPC 4958 (66.67) were found at par with each other.

Per cent Male and Female adult emergence

The genotype JG 9605 (121.33) was found significantly best host seed for the development of bruchids than all other genotypes and the genotype which found significantly less preferred host for development of bruchids is DRRJ 2 x KAK 2 (59.33). Male and female emergence per cent in best host seed JG 9605 is (61.28) and (38.72) respectively, while for most less preferred host seed DRRJ 2 x KAK 2 male and female emergence percent is (52.07) and (47.93) respectively.

Per cent seed weight loss after 3 months

The difference in per cent weight loss due to feeding of pulse beetle, among different chickpea genotype were found to be significant at 5% level of probability. Due to feeding of pulse beetle on different chickpea genotypes, the significantly more weight loss percentage was found in JG 9605 (18.61) followed by JG 30 (17.81), JG 24 (17.68), ICCV 07117 (15.69) and these genotypes were found at par with each other except, JG 14-16 (15.41), which was at par with JG 14 x IPC 4958 (14.68), JG 14 (14.50). The genotypes JG 31, JG 74 x IPC 4958, JG 14-11 were also found at par with an average of (14.33), (12.19), (12.16), respectively and only JG 130 x ICC 11551 (11.45), JGG 2 (09.49), was also found at par with each other. Significantly less per cent weight loss was observed in genotype DRRJ 2 x KAK 2 (09.27).

Under forced condition in Kabuli genotypes

In this experiment, free choice was given to adult beetles for egg laying and ovipositional preference was observed on kabuli genotypes. Observations on number of eggs laid, per cent of adults emerged, percent seed weight loss were recorded and presented in table.

Ovipositional behavior of *C.chinensis*

According to table, data on number of eggs laid on different genotype was statistically analyzed and there was significant difference between numbers of eggs laid on different chickpea genotype at 5% level of probability. The data revealed that cultivar namely JGK 19, was found to be the most preferred host for oviposition with an average of 405.00 eggs which were significantly higher than the average number of eggs laid on any other genotypes. The second group in descending order of preference included ICARDA 16113 x 07, JGK24, JGK 25 and SUBHRA with an average of 395.67, 349.67, 346.33 and 339.00 eggs respectively.

These four genotypes were at par with each other, but significantly most preferred for oviposition than the rest of the genotypes except JGK 19 which rank first. These four genotypes were followed by JGK 17 (337.00), FLIP 01-29 C (332.67) which ranked third in order of preference.

Genotypes viz. JGK 13 (317.33) and JGK 22 (312.67) were at par and significantly more preferred than JGK 1 (307.00) and JGK 1 x JGK 4 (292.00). These two genotypes were also at par. Genotypes JGK 1 x JGK 2 (205.00), JGK 5 (239.67), was found least preferred host for oviposition, followed ICARDA 28118 x 09 (274.00) by and ICARDA 16102 x 07 (280.00).

Per cent adult emergence

The genotype JGK 24 (96.33) was found significantly best host seed for the development of bruchids than all other genotypes. The genotypes JGK 19 (94.00), JGK 1 x JGK 4 (89.67), JGK 1 (89.67), JGK 17 (89.33), JGK 25 (70.00), JGK 24 (84.00) and FLIP 01-29 C (74.33) were statistically found at par with each other. ICARDA 28118 x 09, JGK 5 and SUBHRA are the genotypes more or less preferred host. The genotype which found significantly less preferred host for development of bruchids is JGK 1 x JGK 2 (43.00) followed by JGK 13 (56.33), ICARDA 16113 x 07 (58.33), and the genotypes JGK 22 (62.33), ICARDA 16102 x 07 (63.33) both were found at par with each other.

Per cent Male and Female adult emergence

The genotype JGK 24 (96.33) was found significantly best host seed for the development of bruchids than all other genotypes and the genotype which found significantly less preferred host for development of bruchids is JGK 1 x JGK 2 (43.00). Male and female emergence per cent in best host seed JGK 24 is (47.35) and (52.65) respectively, while for most less preferred host seed JGK 1 x JGK 2 male and female emergence percent is (42.68) and (57.32) respectively.

Per cent seed weight loss after 3 months

The difference in per cent weight loss due to feeding of pulse beetle, among different chickpea genotype were found to be significant at 5% level of probability. Due to feeding of pulse beetle on different chickpea genotypes, the significantly more weight loss percentage was found in JGK 24 (17.93) followed by JGK 13 (17.56), JGK 17 (16.46), JGK 1 (16.46), JGK 22 (15.92) and JGK 19 (15.03) these genotypes were found at par with each other except JGK 5 (14.95), which was at par with JGK 25 (14.33), ICARDA 2818 x 09 (14.17). The genotypes

SUBHRA, FLIP 01-29 C, ICARDA 16102 x 07, JGK 1 x JGK 4 and ICARDA 16113 x 07 were also found at par with an average of (13.81), (12.79), (12.78), (12.78) and (12.28) respectively. Significantly less per cent weight loss was observed in genotype JGK 1 x JGK 2 (09.97).

Experiment No.2: For germination test was conduct to record per cent germination of the selected 15 Deshi and 15 Kabuli genotypes separately, with damage and healthy seeds.

The results of Deshi genotype are given in table.

(A) Damaged seeds: Germination test was conducted with damaged seeds of Deshi genotypes. The data table revealed that significantly more germination per cent was found in DRRJ 2 x KAK 2, JG 31, JG 32 with an average of 61.00, 53.00, 52.00 per cent, respectively, than all other genotypes like JG 24 (40.00), JG 30 (38.00), ICCV 07117 (32.00) and JGG 2 (30.00) were at par with each other. The genotype JG 14, JG 14-16, JG 14-16 x JG 11 and JG 14 x IPC 4958 with an average of 29.00, 25.00, 22.00 and 21.00 respectively, at par with each other. JG 130 x ICC 11551 (20.00) and JG 74 x IPC 4958 (18.00) were both at par to each other. The significantly lowest germination was found in JG 9605 (10.00).

(B) Healthy seeds: Germination test was conducted with healthy seeds of Deshi genotypes. The data given in table shows that significantly more per cent germination was found in DRRJ 2 x KAK 2 (94%), followed by JG 31, JG 32, JG 24, JGG 2, ICCV 07117 and JG 14-16 with an average of 93.00, 89.00, 86.00, 83.00, 81.00 and 81.00 per cent, respectively, which were also found at par with JG 14 (79.00). The genotype JG 14-11 was also found at par with JG 74 x IPC 4958 genotype. The genotype JG 14-16 x JG 11 (72.00%) was also found at par with JG 14 x IPC 4958 (72.00%), which was also found at par with JG 130 x ICC 11551 (71.00%). Significantly lowest germination was recorded in JG 9605 (67.00%).

The seed germination test of 15 Kabuli genotypes was simultaneously conducted in two separate tests.

The results Kabuli genotypes are given in the table.

(A) Damaged seeds: Germination test was conducted with damaged seeds of Kabuli genotypes. The data given in table shows that significantly more germination per cent was found in JGK 1 x JGK 2 (66%) and proved to be the best Kabuli genotype for germination. The genotype JGK 13 (52.00%), FLIP 01-29 C (47.00%), JGK 19 (47.00%) were found at par with each other and JGK 1 (42.00%) was also found at par with ICARDA 16113 x 07 (42.00%), JGK 17 (39.00%), ICARDA 16102 x 07 (39.00%), JGK 1 x JGK 4 (37.00%), and SUBHRA (37.00%). The significantly minimum germination was found in JGK 24 (26.00%) than all other genotypes followed by JGK 25 (27.00%), JGK 5 (35.00%), JGK 22 (36.00%) and ICARDA 28118 x 09 (36.00%) which were also found at par with each other.

(B) Healthy seeds: Germination test was conducted with healthy seeds of Kabuli genotypes. The more germination per cent among 15 genotypes were found in JGK 1 x JGK 2 (90.00%), followed by JGK 19 (89.00%), JGK 13 (86.00%), ICARDA 16102 x 07 (80.00%). All of these genotypes were significantly superior to all other cultivars, which were also found at par with each other and JGK 5 (79.00%), SUBHRA (78.00%) were also found at par with each other. The genotype JGK 1, FLIP 01-29 C and JGK 1 x JGK 4 were equal to each other with average germination per cent of (77.00%). Statistically, the significantly lowest germination per cent was found in JGK 24 (66.00%) than all others genotypes, except JGK 25 (68.00%) which is found at par with JGK 24 followed by the genotype ICARDA 28118 x 09 (72.00%), ICARDA 16113 x 07 (75.00%), JGK 22 (75.00%) and JGK 17 (76.00%).;

Discussion

Since, 30 genotypes were screened for the first time against pulse beetle, exact relevant references were not available. Therefore, the allied references were taken into consideration.

Under free choice condition in Deshi genotypes

Regarding ovipositional preferences JGG 2 was found to the best host and least preferred host was JG 14 × IPC 4958. The reason for preferences may be having smooth surface of seeds and somewhat boldness of seeds. Majumdar (1974) [23] supported this finding with different deshi genotype.

For the development and adult emergence, JG 24 proved to be the best host, and the no. of male and female per cent observed in JG 24 are (52.95) and (47.05) respectively. Again JG 32 was least suitable host for the development and adult emergence of *C chinensis*, and the no. of male and female per cent observed in JG 32 are (58.04) and (42.97). Singh *et al*. (2001) [44] found similar results in pea genotypes screened against *C chinensis*.

Regarding per cent seed weight loss of chickpea genotypes due to infestation of Callosobruchus *chinensis*, JG 14 X IPC 4958 and JG 14 were observed more susceptible due to more per cent loss in weight. However, JG 32 was recorded as less susceptible genotype. The finding of Rai and Singh (1989) [32] showed least per cent loss in weight in G-130 cultivar which is also supportive to present finding.

Under free choice condition in Kabuli genotypes

Among 15 Kabuli genotypes which were screened in present investigation, JGK 17 was found significantly more preferred and best host and significantly least preferred host was JGK 1 x JGK 2. The reason for preferences may be having smooth surface of seeds and somewhat boldness of seeds. Earlier workers Thingbaijam *et al*. (1981) [49] reported that the cultivar JG-12 (Kabuli) was more preferred for purpose of oviposition by *C chinensis.*

Regarding development and adult emergence, JGK 5 proved to be the best host, and the no. of male and female per cent observed in JGK 5 are (48.98) and (51.02) respectively. Again JGK 1 x JGK 2 was least suitable host for the development and adult emergence of *C chinensis*, and the no. of male and female per cent observed in JGK 1 x JGK 2 are (50.53) and (49.47).

Due to feeding of pulse beetle on different Kabuli genotypes per cent seed weight loss found maximum in, JGK 24. However, JGK 1 x JGK 2 was recorded as less susceptible genotype. The finding of Rai and Singh (1989) [32] showed least per cent loss in weight in G-130 cultivar which is also supportive to present finding.

Under forced condition in Deshi genotypes

Among Deshi genotypes, JG 14 was significantly more preferred host for purpose of oviposition by pulse beetle. The genotype DRRJ 2 x KAK 2 was found least suitable for the

purpose of oviposition. Earlier, Sharvale and Borikar (1995) [42] reported that the cultivars L 550 and Phule G 1 were highly suitable for the purpose of oviposition.

Regarding development and adult emergence, JG 9605 proved to be the best host, and the no. of male and female per cent observed in JG 9605 are (61.28) and (38.72) respectively. Again DRRJ 2 x KAK 2 was least suitable host for the development and adult emergence of *C chinensis*, and the no. of male and female per cent observed in DRRJ 2 x KAK 2 are (52.07) and (47.93).

Due to feeding of *C chinensis* on different chickpea genotypes, the significantly more weight loss was found in JG 9605 and JG 30 and significantly less per cent seed weight loss was found in DRRJ 2 x KAK 2. These findings are supported by Khattak *et al*. (2001), who studied the screened of ten chickpea genotypes.

Under forced condition in Kabuli genotypes

The data revealed that the Kabuli genotype JGK 19 was found significantly less preferred host for oviposition by *C chinensis.* The genotype JGK 1 x JGK 2 was found significantly less preferred host for purpose of oviposition by *C chinensis.* These findings were supported by other workers like Khattak *et al*. (2001) studied the oviposition of pulse beetle both in Deshi and Kabuli genotypes

Regarding development and adult emergence, JGK 24 proved to be the best host, and the no. of male and female per cent observed in JGK 24 are (47.35) and (52.65) respectively. Again JGK 1 x JGK 2 was least suitable host for the development and adult emergence of *C chinensis*, and the no. of male and female per cent observed in JGK 1 x JGK 2 are (42.68) and (57.32). Hamed *et al*. (1994) studied 18 local mutants/cultivars of chickpea for resistance to *C chinensis* in storage and found that CMN-1-9/86 and CMN-1-3/86 have less adult emergence than CMNK-15/86, CMN-426-1/86 and CMN-187/85.

Due to feeding of *C chinensis* on different chickpea genotypes, the significantly more weight loss was found JGK 24 and JGK 13 and significantly less per cent seed weight loss was found in JGK 1 x JGK 2. These findings are supported by Khattak *et al*. (2001), who studied the screened of ten chickpea genotypes. Rajput (1993) reported that the genotypes K-444, SI-90/1, KPG-53 and C-235 were found comparatively more susceptible against pulse beetle on the basis of seed infestation and per cent loss in weight to other genotypes.

Effect of *Callosobruchus chinensis* (L) on seed germination

In the presented study, it is observed that the seed germination was affected due to damage of *C chinensis.* In deshi genotype in the healthy seeds of DRRJ 2 x KAK and JG 31, the germination was 94% and 93%, while in the damaged seeds of the same genotypes, the germination was 61 and 53 per cent, respectively.

In kabuli genotypes, in the healthy seeds of JGK 1 x JGK 2 the germination was observed 90 per cent, while in the damaged seeds, the germination reduced to 66 per cent. The present study coincides with the study of Singh *et al.* (1994) [21] who worked on soybean and reported the seed germination was also affected in damaged seeds. Jatwani and Sircar (1964) [17] who worked on pea seeds reported the per cent germination from 44.00 to 0.00 per cent in varying degrees o0f damage as against 73.2 per cent in healthy seeds.

Conclusion

Screening of 30 genotypes was done to find out the resistant genotypes against pulse beetle *C chinensis* (L) in storage and best post harvest maintenance of chickpea seeds. Data on effect of the activity of *C chinensis* (L) in free choice and forced condition on the oviposition, adult emergence per cent, male and female emergence per cent were recorded. Data on effect of feeding of *C chinensis* (L) on germination of seed viability and per cent weight loss due to infestation were also recorded.

The results obtained are summarized here under.

Under free choice condition in Deshi genotype

The data revealed that genotype JGG 2, was found to be the most preferred host for oviposition with an average of 207.67 eggs and genotype JG 14 × IPC 4958 was found least preferred host for oviposition (64.67) eggs.

The seeds of the genotype JG 24 proved to be the best host for the development which leads to adult emergence (90.67%), followed by JG 14-11 (81.00) and were statistically at par. Genotype JG 32 with (30.00) adult emergence was found to be the least suitable host for the development of pulse beetle.

Male and female emergence per cent in best host genotype seed JG 24 is (52.95) and (47.05) respectively, while for most less preferred host genotype seed JG 32 male and female emergence percent is (58.04) and (42.97) respectively.

The significantly more percentage weight loss was found in JG 14 x IPC 4958 (93.29%), followed by JG 14 (86.44%) and both genotypes were found at par. Significantly less per cent seed weight loss was observed in genotype JG 32 (15.85%)

Under free choice condition in Kabuli genotype

The data revealed that genotype JGK 17, was found to be the most preferred host for oviposition with an average of 199.00 eggs and genotype JGK 1 x JGK 2 was found least preferred host for oviposition (99.33) eggs.

The seeds of the genotype JGK 5 proved to be the best host for the development which leads to adult emergence (80.67%), followed by JGK 19 (77.00%) and were statistically at par. Genotype JGK 1 x JGK 2 with (49.33%) adult emergence was found to be the least suitable host for the development of pulse beetle.

Male and female emergence per cent in best host genotype seed JGK 5 is (48.98) and (51.02) respectively, while for most less preferred host genotype seed JGK 1 x JGK 2 male and female emergence percent is (50.53) and (49.47) respectively.

The significantly more percentage weight loss was found in JGK 24 (50.05%), followed by JGK 5 (35.25%) and both genotypes were found at par. Significantly less per cent seed weight loss was observed in genotype JGK 1 x JGK 2 (10.74%).

Under forced condition in Deshi genotype

The data revealed that genotype JG 14, was found to be the most preferred host for oviposition with an average of 685.00 eggs and genotype DRRJ 2 x KAK 2 was found least preferred host for oviposition (319.67) eggs.

The seeds of the genotype JG 9605 proved to be the best host for the development which leads to adult emergence (121.33%), followed by JG 30 (101.00%) and were statistically at par. Genotype DRRJ 2 x KAK 2 with (59.33%) adult emergence was found to be the least suitable host for the development of pulse beetle.

Male and female emergence per cent in best host genotype seed JG 9605 is (61.28) and (38.72) respectively, while for

most less preferred host genotype seed DRRJ 2 x KAK 2 male and female emergence percent is (52.07) and (47.93) respectively.

The significantly more percentage weight loss was found in JG 9605 (18.61%), followed by JG 30 (17.81%) and both genotypes were found at par. Significantly less per cent seed weight loss was observed in genotype DRRJ 2 x KAK 2 (09.27%)

Under forced condition in Kabuli genotype

The data revealed that genotype JGK 19, was found to be the most preferred host for oviposition with an average of 405.00 eggs and genotype JGK 1 x JGK 2 was found least preferred host for oviposition (205.00) eggs.

The seeds of the genotype JGK 24 proved to be the best host for the development which leads to adult emergence (96.33%), followed by JGK 19 (94.00%) and were statistically at par. Genotype JGK 1 x JGK 2 with (43.00%) adult emergence was found to be the least suitable host for the development of pulse beetle.

Male and female emergence per cent in best host genotype seed JGK 24 is (47.35) and (52.65) respectively, while for most less preferred host genotype seed JGK 1 x JGK 2 male and female emergence percent is (42.68) and (57.32) respectively.

The significantly more percentage weight loss was found in JGK 24 (17.93%), followed by JGK 5 (35.25%) and both genotypes were found at par. Significantly less per cent seed weight loss was observed in genotype JGK 1 x JGK 2 (09.97%) than all other genotypes.

Germination percentage in Deshi and Kabuli genotypes

Germination test was conducted to record per cent germination of the selected 15 Deshi and 15 Kabuli genotypes separately, with damaged and healthy seeds.

Percentage germination was recorded in the range of 10.00 to 61.00 per cent with damaged seeds of Deshi genotype viz., JG 9605 and DRRJ 2 x KAK 2. Similarly, percentage germination was also observed with healthy Deshi genotype, ranged from 67.00 to 94.00 per cent viz., JG 9605 and DRRJ 2 x KAK 2.

Percentage germination was recorded 26.00 to 66.00 per cent with damaged seeds of Kabuli genotype, viz., JGK 24 and JGK 1 x JGK 2. Similarly percentage germination was also observed with healthy Kabuli genotype, ranged from 66.00 to 90.00 per cent viz., JGK24 and JGK1 x JGK2.

Table 1: Effect of Different Deshi Genotypes of Chick Pea on the Population Build Up of *C. Chinensis* and (%) Seed Weight Loss

10 Gram Deshi Genotypes Under Free Choice Condition							
S. No.	**Name of genotypes**	**Seed size**	**Oviposition**	**Total Adult emergence (%)**	**Male emergence (%)**	**Female emergence (%)**	**Seed weight loss (%) after 3 months**
1	JG 31	BOLD	134.00 (11.59)	33.00 (24.58)	45.26(42.25)	54.74 (47.72)	23.45 (28.90)
2	ICCV 07117	MEDIUM	194.33 (13.96)	72.33 (37.19)	48.40 (44.06)	51.60 (45.90)	21.02 (27.24)
3	JG 130×ICC 11551	BOLD	82.00 (09.07)	31.67 (39.22)	53.34 (46.92)	46.66 (43.05)	25.01 (29.99)
4	JGG 2	BOLD	207.67 (14.42)	79.33 (38.21)	49.62 (44.76)	50.38 (45.20)	28.79 (32.42)
5	JG 14-16×JG 11	BOLD	174.00 (13.20)	59.00 (33.94)	54.27 (47.43)	45.73 (42.53)	31.72 (34.21)
6	JGG 24	BOLD	177.67 (13.34)	90.67 (51.02)	52.95 (46.68)	47.05 (43.28)	85.48 (67.96)
7	DRRJ 2×KAK 2	LARGE	127.33 (11.30)	60.67 (47.67)	49.87 (44.91)	50.13 (45.06)	70.47 (57.06)
8	JG 30	SMALL	162.67 (12.77)	71.33 (43.86)	50.49 (45.26)	49.97 (44.97)	53.94 (47.25)
9	JG 14-11	BOLD	192.33 (13.88)	81.00 (42.14)	54.27 (47.43)	45.73 (42.53)	49.32 (44.59)
10	JG 14×IPC 4958	MEDIUM	64.67 (08.06)	33.33 (51.78)	53.53 (47.04)	46.67 (42.92)	93.29 (75.52)
11	JG 32	MEDIUM	117.00 (10.83)	30.00 (25.59)	58.04 (49.66)	42.97 (40.91)	15.85 (23.43
12	JG 14-16	MEDIUM	131.00 (11.46)	59.00 (45.15)	49.64 (44.77)	50.36 (45.19)	49.34 (44.60)
13	JG 14	BOLD	84.67 (09.22)	51.33 (60.65)	47.68 (43.64)	52.32 (46.32)	86.44 (68.65)
14	JG 74×IPC 4958	BOLD	82.33 (09.09)	59.67 (72.65)	56.22 (48.57)	43.78 (41.39)	72.45 (58.34)
15	JG 9605	SMALL	155.33 (12.48)	51.33 (33.07)	50.74 (45.41)	42.26 (44.55)	17.66 (24.83)
SEm±			3.90	2.33	2.09	2.04	1.73
CD at 5%			11.25	6.73	6.03	5.90	4.98

Value in the paranthesis are the transform value

Table 2: Effect of Different Kabuli Genotypes of Chick Pea on the Population Build Up Of *C. Chinensis*and (%) Seed Weight Loss

10 Gram Kabuli Genotypes Under Free Choice Condition							
S. No.	**Name of genotypes**	**Seed size**	**Oviposition**	**Total Adult emergence (%)**	**Male emergence (%)**	**Female emergence (%)**	**Seed weight loss (%) after 3 months**
1	JGK 17	LARGE	199.00 (14.12)	74.00 (37.18)	44.34 (41.72)	51.28 (45.72)	20.49 (26.90)
2	JGK 1	LARGE	195.67 (14.00)	61.67 (31.50)	46.60 (42.69)	54.00 (47.28)	24.49 (29.64)
3	JGK 1×JGK 4	MED. LARGE	194.67 (13.96)	52.67 (27.04)	38.57 (38.37)	61.43 (51.60)	14.08 (19.04)
4	JGK 1×JGK 2	LARGE	99.33 (09.99)	49.33 (49.54)	50.53 (45.29)	49.47 (44.67)	10.74 (22.01)
5	ICARDA 28118×09	LARGE	180.00 (13.43)	70.00 (38.81)	54.03 (47.30)	45.97 (42.66)	20.49 (26.90)
6	JGK 13	LARGE	150.33 (12.28)	71.67 (47.73)	49.89 (44.92)	50.11 (45.04)	27.66 (31.72)
7	ICARDA 16113×07	MED. LARGE	176.00 (13.28)	64.67 (36.76)	48.55 (44.15)	51.45 (45.82)	18.65 (25.51)
8	JGK 5	EXTRALARGE	163.33 (12.80)	80.67 (49.42)	48.98 (44.40)	51.02 (45.57)	35.25 (36.38)
9	JGK 25	LARGE	102.00 (10.11)	56.00 (54.86)	51.32 (45.74)	48.68 (44.23)	29.34 (32.77)
10	ICARDA 16102×07	MED. LARGE	183.33 (13.56)	58.00 (31.63)	44.72 (41.92)	55.28 (48.04)	28.79 (32.42)
11	FLIP 01-29C	EXTRALARGE	198.67 (14.10)	72.00 (36.28)	52.43 (46.38)	47.57 (43.58)	26.00 (30.52)
12	SUBHRA	MED. LARGE	156.67 (12.53)	61.00 (38.92)	46.98 (43.25)	53.02 (46.71)	29.67 (32.78)
13	JGK 19	LARGE	184.33 (13.59)	77.00 (41.77)	45.98 (42.66)	54.02 (47.30)	31.14 (33.81)
14	JGK 22	EXTRALARGE	178.67 (13.38)	66.00 (36.97)	47.44 (43.51)	52.56 (46.45)	21.71 (27.53)
15	JGK 24	LARGE	119.33 (10.94)	69.67 (58.53)	52.32 (46.33)	47.68 (43.63)	50.05 (45.01)
SEm±			4.89	1.14	2.02	2.02	1.74
CD at 5%			14.13	3.29	5.85	5.84	5.02

Value in the paranthesis are the transform value

Table 3: Effect of Different Deshi Genotypes of Chick Pea on the Population Build Up of *C. Chinensis*and (%) Seed Weight Loss

50 Gram Deshi Genotypes Under Forced Condition							
S. No.	**Name of genotypes**	**Seed size**	**Oviposition**	**Total Adult emergence (%)**	**Male emergence (%)**	**Female emergence (%)**	**Seed weight loss (%) after 3 months**
1	JG 31	BOLD	331.67 (18.22)	68.67 (20.70)	62.70 (52.43)	37.30 (37.53)	14.33 (22.23)
2	ICCV 07117	MEDIUM	427.00 (20.68)	80.67 (18.91)	48.50 (44.12)	51.50 (45.85)	15.69 (23.31)
3	JG 130×ICC 11551	BOLD	406.00 (20.16)	99.33 (24.46)	50.10 (45.04)	49.90 (44.92)	11.45 (19.75)
4	JGG 2	BOLD	419.33 (20.49)	68.67 (16.37)	59.18 (50.28)	40.82 (39.69)	09.49 (17.93)
5	JG 14-16×JG 11	BOLD	391.67 (19.80)	68.00 (17.36)	51.83 (46.03)	48.17 (43.93)	15.09 (22.85)
6	JGG 24	BOLD	413.00 (20.33)	62.00 (15.01)	54.46 (47.60)	52.65 (46.50)	17.68 (24.85)
7	DRRJ 2×KAK 2	LARGE	319.67 (17.89)	59.33 (18.57)	52.07 (46.18)	47.93 (43.79)	09.27 (22.38)
8	JG 30	SMALL	471.33 (21.71)	101.00 (21.36)	55.07 (47.92)	44.93 (42.05)	17.81 (24.94)
9	JG 14-11	BOLD	470.00 (21.69)	72.00 (15.31)	52.38 (46.35)	47.62 (43.62)	12.16 (20.40)
10	JG 14×IPC 4958	MEDIUM	454.33 (21.32)	63.33 (13.94)	38.98 (38.57)	61.07 (51.40)	14.68 (22.52)
11	JG 32	MEDIUM	357.67 (18.92)	70.33 (19.66)	50.94 (45.52)	49.06 (44.44)	14.04 (21.99)
12	JG 14-16	MEDIUM	443.67 (21.07)	79.33 (17.88)	48.68 (44.22)	42.59 (40.60)	15.41 (23.10)
13	JG 14	BOLD	685.00 (26.18)	72.33 (10.57)	49.93 (44.94)	50.07 (45.02)	14.50 (17.72)
14	JG 74×IPC 4958	BOLD	365.67 (19.13)	66.67 (18.22)	57.30 (49.19)	42.70 (40.77)	12.19 (20.43)
15	JG 9605	SMALL	477.67 (21.86)	121.33 (25.42)	61.28 (51.51)	38.72 (38.46)	18.61 (19.75)
SEm±			7.32	0.48	1.85	1.84	0.43
CD at 5%			21.14	1.40	5.35	5.31	1.25

Value in the paranthesis are the transform value

Table 4: Effect of Different Kabuli Genotypes of Chick Pea on the Population Build Up of *C. Chinensis*and (%) Seed Weight Loss

50 Gram Kabuli Genotypes Under Forced Condition							
S.No.	**Name of genotypes**	**Seed size**	**Oviposition**	**Total Adult emergence (%)**	**Male emergence (%)**	**Female emergence (%)**	**Seed weight loss (%) after 3 months**
1	JGK 17	LARGE	337.00 (18.37)	89.33 (26.49)	49.67 (44.79)	50.33 (45.17)	16.46 (23.92)
2	JGK 1	LARGE	307.00 (17.53)	89.67 (29.17)	50.37 (45.20)	49.63 (44.77)	16.46 (23.92)
3	JGK 1×JGK 4	MED. LARGE	292.00 (17.01)	89.67 (30.69)	54.56 (47.60)	45.44 (42.36)	12.78 (25.04)
4	JGK 1×JGK 2	LARGE	205.00 (14.32)	43.00 (20.91)	42.68 (40.76)	57.32 (49.20)	09.97 (20.50)
5	ICARDA 28118×09	LARGE	274.00 (16.56)	72.00 (26.29)	54.66 (47.66)	45.34 (42.31)	14.17 (22.09)
6	JGK 13	LARGE	317.33 (17.82)	56.33 (17.75)	57.51 (49.32)	42.49 (40.64)	17.56 (24.76)
7	ICARDA 16113×07	MED. LARGE	395.67 (19.90)	58.33 (14.74)	56.13 (48.51)	43.87 (41.45)	12.28 (18.39)
8	JGK 5	EXTRALARGE	239.67 (15.50)	71.67 (29.96)	51.88 (46.06)	48.12 (43.90)	14.95 (22.73)
9	JGK 25	LARGE	346.33 (18.62)	84.00 (24.25)	50.92 (45.52)	49.08 (44.45)	14.33 (22.23)
10	ICARDA 16102×07	MED. LARGE	280.00 (18.74)	63.33 (22.62)	51.57 (45.88)	48.43 (44.08)	12.78 (20.94)
11	FLIP 01-29C	EXTRALARGE	332.67 (18.25)	74.33 (22.34)	60.10 (50.82)	39.90 (39.15)	12.79 (20.93)
12	SUBHRA	MED. LARGE	339.00 (18.42)	65.00 (19.19)	47.18 (43.36)	52.82 (46.60)	13.81 (21.80)
13	JGK 19	LARGE	405.00 (20.14)	94.00 (23.22)	50.31 (45.16)	49.69 (44.80)	15.03 (22.80)
14	JGK 22	EXTRALARGE	312.67 (17.69)	62.33 (19.93)	51.79 (46.01)	48.21 (43.95)	15.92 (23.50)
15	JGK 24	LARGE	349.67 (17.70)	96.33 (27.54)	47.35 (43.46)	52.65 (46.50)	17.93 (20.94)
SEm±			4.16	0.78	1.31	1.31	0.40
CD at 5%			12.02	2.27	3.77	3.77	1.15

Value in the paranthesis are the transform value

Table 5: Response of different genotypes of chickpea deshi on the seed germination with and without *C.chinensis*

Germination Percentage Of Different Chickpea Genotype After 3 Months					
S. No.	**Genotypes**	**Germination percentage of chick pea genotypes After 3 months upto 72 hours**			
		Damaged seeds		**Healthy seeds**	
1	JG 31	53.00	(46.70)	93.00	(74.71)
2	ICCV 07117	32.00	(34.41)	81.00	(64.15)
3	JG 130×ICC 11551	20.00	(26.54)	71.00	(57.40)
4	JGG 2	30.00	(33.19)	83.00	(65.76)
5	JG 14-16×JG 11	22.00	(27.95)	72.00	(58.04)
6	JG 24	40.00	(39.21)	86.00	(68.08)
7	JG 9605	10.00	(18.41)	67.00	(54.92)
8	JG 30	38.00	(38.03)	83.00	(65.65)
9	JG 14-11	24.00	(29.26)	74.00	(59.34)
10	JG 14×IPC 4958	21.00	(27.26)	72.00	(58.08)
11	JG 32	52.00	(46.13)	89.00	(70.71)
12	JG 14-16	25.00	(29.96)	81.00	(64.17)
13	DRRJ 2×KAK 2	61.00	(51.36)	94.00	(75.92)
14	JG 74×IPC 4958	18.00	(25.01)	74.00	(59.34)
15	JG 14	29.00	(32.56)	79.00	(62.71)
	SEM ±	1.26		1.25	
	CD (P=0.05)	3.65		3.61	

Table 6: Response of different genotypes of chickpea Kabuli on the seed germination with and without *C.chinensis*

Germination Percentage Of Different Chickpea Genotype After 3 Months					
S. No.	**Genotype**	**Germination Percentage Of Chick Pea Genotypes After 3 Months Upto 72 Hours**			
		Damaged seeds		**Healthy seeds**	
1	JGK 17	39.00	(38.63)	76.00	(60.66)
2	JGK 1	42.00	(40.38)	77.00	(61.35)
3	JGK 24	26.00	(30.59)	66.00	(54.32)
4	ICARDA 16113×07	42.00	(40.38)	75.00	(60.00)
5	ICARDA 28118×09	36.00	(36.85)	72.00	(58.04)
6	JGK 13	52.00	(46.13)	86.00	(68.06)
7	JGK 1×JGK 2	66.00	(54.32)	90.00	(71.67)
8	JGK 5	35.00	(36.24)	79.00	(62.77)
9	JGK 25	27.00	(31.26)	68.00	(55.54)
10	ICARDA 16102×07	39.00	(38.60)	80.00	(63.44)
11	FLIP 01-29C	47.00	(43.26)	77.00	(61.35)
12	SUBHRA	37.00	(37.42)	78.00	(62.08)
13	JGK 19	47.00	(43.26)	89.00	(70.75)
14	JGK 22	36.00	(36.84)	75.00	(60.02)
15	JGK 1×JGK 4	37.00	(37.45)	77.00	(61.36)
	SEM ±	1.14		1.27	
	CD (P=0.05)	3.30		3.68	

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