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Heterotic Studies For Yield And Yield Components Coupled With Stem Rot Resistance In Groundnut (*Arachis Hypogaea* L.)

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ABSTRACT

As groundnut cultivation is hampered by stem rot disease incidence causing yield loss up to 20%. Hence, the present study aimed to identify highly heterotic cross combinations for pod yield and stem rot resistance. Nine parents (five lines and four testers) along with 20 F_1 crosses were evaluated for yield, yield component traits and stem rot resistance to estimate the magnitude of heterosis in stem rot sick plot and control condition during rabi, 2019.The cross, ICGV-07262 x TCGS-1862 was identified as the best heterotic cross for pod yield plant^{-1} and its components and also the predominance of over dominance effects was observed for yield and its components over standard resistant tester J-11 in sick plot condition and over standard line Kadiri-6 in control condition, respectively. The crosses viz., Narayani x J-11, Kadiri-6 x CS-19, ICGV-07262 x TCGS-1862 and ICGV-07262 x TCGS-2149 were identified as best cross combinations for both yield and stem rot resistance. Hence, these crosses are exploited in groundnut-resistant breeding program to delineate the best heterotic potential present in the crop for further improvement.

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Introduction

Groundnut is well known important oilseed crop in the world and in India because of its economic importance. The seed is comprised of 40-54 per cent oil, 25-28 per cent protein and 18 per cent of carbohydrates in addition to minerals and vitamins including vitamin E, niacin, phosphorus, falcin, calcium, riboflavin, magnesium, zinc, iron, thiamine, and potassium.

Globally, it is cultivated in an area of 29.92 Mha with annual production of 55.30 Mt and productivity of 1851 kg ha^{-1} [1]. In India, groundnut covers an area of 60.9 lakh ha with a production of 10.21 Mt and productivity of 1676 kg ha^{-1}. In Andhra Pradesh, it is cultivated in an area of 8.24 lakh ha with a production of 5.19 Mt and productivity of 631 kg ha^{-1} [2]. Among the major groundnut-growing states of India, Gujarat and Andhra Pradesh are ranking first and second in terms of area, respectively.

The major growing states are Gujarat, Andhra Pradesh, Telangana, Tamil Nadu, Karnataka, Rajasthan and Maharashtra. These constitute around 80 per cent of total area and production. In Andhra Pradesh, Several factors like edaphic, climate, pests and diseases prevailing in the environment hinders yield, especially stem rot disease incidence at the time of harvest causing yield loss up to 25 %. Hence, there is a need to focus on the enhancement of yield along with stem rot resistance through breeding followed by meticulous selection in advanced generations.

The superiority of F_1 over the parents in terms of yield or some other yield-related traits is commonly referred to as heterosis or hybrid vigor. The commercial exploitation of heterosis in groundnut has limited application because of the practical difficulties of the cleistogamous nature of flower, difficulty in emasculation, pollination of flowers and hybrid seed production in sufficient quantity. However, the nature and magnitude of heterosis help in identifying superior cross combinations and their exploitation to get better transgressive segregants in the advanced generations [3]. Exploitation of heterosis is of direct interest for developing hybrids in cross-pollinated crops but it is also of importance in self-pollinated crops where such feasibility existed. The allopolyploidy nature of groundnut will also favor the preservation of such hybrid vigor for a considerable number of generations. The knowledge of heterosis would also help in the elimination of poor crosses in the early generation of testing itself.

Hence, the heterosis assumes importance in breeding as heterotic crosses have the potential to throw out superior segregants in subsequent generations. The estimates of heterosis provide information about the nature of gene action involved in the expression of yield and its contributing traits. The information is also essential to formulate efficient breeding program for the improvement of the crop. In the present investigation, the standard heterosis was calculated with the 'Kadiri-6' variety as the check variety in the control condition as it was the most popular and preferred national check variety in recent years and 'J-11' variety in the sick plot condition as it was a most popular tolerant check for stem rot incidence. For the traits *viz.*, days to 50% flowering, days to maturity, SLA at 60 DAS, plant height and number of immature pods plant^{-1} the heterosis in the negative direction is generally considered desirable.

Materials And Methods

The experimental material for this study consisted of nine parents (five lines *viz*., Kadiri-6, Narayani, TAG-24, ICGV-07262 and ICGV-91114 and four testers *viz*., TCGS-1862, TCGS-2149, J-11, and CS-19) and 20 F_1 crosses derived by line x tester mating fashion among the parents (*kharif*, 2019). The salient features of parents are presented in Table 1.

The nine parents and 20 F_1 crosses were sown in randomized block design, replicated twice during *rabi*, 2019 in sick plot (Plate 1) and control condition (Plate 2) simultaneously. Each entry was sown in a row by dibbling the seeds in 3 m length, with a spacing of 30 cm between the rows and 10 cm within the row. The crop was artificially inoculated with *sclerotium* fungus multiplied in sorghum grains between inter rows followed by mulching with paddy straw to the entire field after 30 DAS, 60 DAS and irrigation was given frequently through drip pipes to conserve moisture which aggravate the mycelium and aids in further multiplication in the sick plot. Common crop management practices like plant protection, weeding and irrigation were carried out to maintain good crop growth in controlled conditions. Each entry was grown in two rows of 3 m in length with a spacing of 22.5 x 10 cm. Data was recorded in 5 randomly selected plants for yield and yield components along with PDI (Percent Disease Incidence) at maturity recorded as per the procedure outlined by [4]. The observations were recorded on five randomly tagged competitive plants from the centre of row in each genotype in each replication for all the yield and yield component traits (SCMR at 60 DAS, SLA at 60 DAS, harvest index, plant height, number of primary branches per plant, number of pegs per plant, number of pods per plant, number of mature pods per plant, number of immature pods per plant, 100 pod weight, 100 kernel weight, sound mature kernel %, shelling percent, dry haulm yield per plant, pod yield per plant, kernel yield per plant, oil and protein content) except days to 50% flowering and days to maturity which were recorded on per plot basis. The mean of these five plants were used to compute mid-parent heterosis (MH), better-parent heterosis (BH) and standard-heterosis (SH). Percent mid-parent heterosis (MH), better-parent heterosis (BH) and standard-heterosis for twenty traits were presented from Tables 2 to 13 respectively. The superiority of F_1 over the mid-parent and better-parent was estimated as per the formula given by [5] and [6] respectively. The significance of heterosis was tested by using 't-test' as suggested by [7] and [8].

Results and Discussion

The degree of heterosis varied from cross to cross for all the traits. Considerable heterosis in certain crosses and low heterosis in others revealed varied nature of genetic diversity and gene action with the genetic make-up of the parents used in the present study. Percent mid-parent heterosis (MH), better-parent heterosis (BH) and standard-heterosis (SH) for yield, yield components and stem rot resistance in sick plot condition and control condition among 20 F_1 crosses of groundnut was furnished in Table 2 to 13.

3.1 Mid-parent heterosis

Mid-parent heterosis is useful in the identification of crosses showing the presence of a dominant gene effect. In sick plot condition, two crosses *viz*., ICGV-91114 x TCGS-1862 (-8.06%) and ICGV-91114 x TCGS-2149(-8.47%) recorded desirable mid-parent heterosis for early flowering. Similarly, three crosses *viz*., TAG-24 x TCGS-2149 (-5.78), Kadir-6 x J-11(-4.72), and ICGV-07262 x TCGS-2149 (-4.60) have registered mid-parent heterosis in desirable direction for early maturity. In the contrary, two crosses *viz*., TAG-24 x TCGS-1862 (-5.70%) and ICGV-91114 x CS-19 (-8.73%) registered desirable negative and significant mid-parent heterosis for days to maturity. Hence, these crosses could yield early flowering segregants in further generations. Desirable negative and significant heterosis in earliness helps the crop to escape from late-stage abiotic stress *i.e*., drought conditions. [9], [10], [11], [12], [13] and [14] also revealed negative mid-parent heterosis for early flowering and maturity in their studies.

Interestingly, all F_1 crosses in sick plot and control condition registered mid-parent heterosis for SLA at 60 DAS except TAG-24 x TCGS-1862, ICGV-91114 x TCGS-2149 and ICGV-91114 x J-11 in sick plot condition suggesting that these crosses could be exploited for the development of desirable water use efficient groundnut genotypes as they recorded negative and significant mid parent heterosis for this character. In groundnut low SLA is desirable because it has been demonstrated that variation in water use efficiency was caused by variation in photosynthetic capacity [15] and a significant negative correlation between photosynthetic capacity and SLA [16].

Among the crosses, Narayani x J11 exhibited mid-parent heterosis for the traits *viz*., number of flowers plant^{-1}from 25 to 50 DAS (sick:24.17%; control:22.44%), number of pegs plant^{-1}(sick:41.93%;control:26.76%), number of pods plant^{-1}(sick:26.22%; control:42.56%), number of mature pods plant^{-1} (sick:17.94%; control:48.54%), Sound Mature kernel (%) (sick:7.87% ; control:3.82%), dry haulm weight plant^{-1}(sick:88.82%;control:46.14%), pod yield plant^{-1}(sick:33.98%;control:8.52%), kernel yield plant^{-1}(sick:56.10% ;control:13.40%) and PDI at maturity (sick:-55.77%; control:-99.82%) in a desirable direction.

Similarly, Kadiri-6 x CS-19 reported significant heterosis over mid-parent in desirable direction for the traits *viz*., number of pods plant^{-1}(sick: 13.11%; control:16.25%), number of immature pods plant^{-1}(sick:-55.96%;control:-30.49%), number of mature pods plant^{-1} (sick:22.54%; control:25.88%), dry haulm weight plant^{-1}(sick:67.94%; control:46.02%), pod yield plant^{-1} (sick:30.67%; control:9.24%), kernel yield plant^{-1} (sick:38.25%; control:14.39%) and PDI at maturity (sick:-73.85% ; control:-99.73%).

Another cross ICGV-07262 x TCGS-2149 recorded desirable significant mid-parent heterosis for the traits *viz*., number of flowers plant^{-1}from 25 to 50 DAS (sick:10.11%;control:8.12%), SMK(%) (sick: 13.68%;control:4.57%), dry haulm weight plant^{-1}(sick:87.90%; control:53.86%), pod yield plant^{-1} (sick:28.38%; control:7.32%), kernel yield plant^{-1}(sick:71.12%;control:12.37%) and PDI at maturity (sick:-48.48%;control:0.00%).

The next better choice is ICGV-07262 x TCGS-1862 showed positive and significant mid-parent heterosis for the traits *viz*., SCMR at 60 DAS (sick:9.83%; control:7.97%), number of pods plant^{-1}, (sick:26.83%;control:17.62%), dry haulm weight plant^{-1} (sick:94.71%; control:65.47%), pod yield plant^{-1} (sick:28.11%; control:19.00%), kernel yield plant^{-1}(sick:65.76%;control:26.84%) and PDI at maturity (sick:-56.00%; control:0.00%). The cross, TAG-24 x TCGS-2149 (9.15%) is identified as best heterotic cross for harvest index in control condition.

The present study affirmed the manifestation of heterosis in yield through heterosis of its component traits. The result of mid-parent heterosis in desirable direction for SCMR at 60 DAS, number of podsplant^{-1}, dry haulm weightplant^{-1}, pod yield and kernel yield plant^{-1}was in congruence with the reports of [12]. [17] reported the desirable mid-parent heterosis for a number of pods plant^{-1}, sound mature kernel %, pod yield and kernel yieldplant^{-1} in their study. Similar kind of desirable mid-heterosis for a number of pods plant^{-1}, a number of mature pods plant^{-1}, pod yield and kernel yield plant^{-1} was in agreement with the findings of [13].

3.2. Better-parent heterosis

The appreciable magnitude of heterosis for important yield and yield components over better parent was perceived in the present study. This type of heterosis is evident to identify the presence of over-dominant effects for specific traits. The crosses *viz.*, ICGV-91114 x TCGS-1862 (-17.39%), ICGV-91114 x TCGS-2149 (-14.29%), ICGV-91114 x J-11 (-12.50%), ICGV-91114 x CS-19 (-12.12%) flowered earlier than better parent while the crosses *viz*., ICGV-91114 x TCGS-2149 (-11.16%), ICGV-91114 x TCGS-1862 (-9.55%), ICGV-91114 x J-11 (-8.52%), ICGV-07262 x TCGS-2149, ICGV-07262 x CS-19 (-6.44%) and TAG-24 x TCGS-2149 attained early maturity than the better parent in sick plot. The crosses *viz*., Kadiri-6 x TCGS-2149 (-16.67%), TAG 24 x TCGS-2149 (-15.15%) and TAG 24 x J-11, TAG 24 x CS-19, Kadiri-6 x TCGS-1862 (-12.12%) attained early flowering in control condition. Likewise, the crosses *viz*., Narayani x TCGS-1862 (-10.92%), Narayani x J-11 (-10.57%), TAG-24 x TCGS-1862 (-9.66%), ICGV-91114 x CS-19 (-9.57%), Kadiri-6 x TCGS-1862 (-6.72%), Narayani x CS-19(-6.52%), ICGV-07262 x TCGS-1862(-6.30%), Narayani x TCGS-2149 (-6.19%) also registered desirable better-parent heterosis in control condition. Since line, ICGV-91114 and tester TCGS-2149 are common parents in most of the crosses and thus they were identified as the better parents for earliness in the present study. Similar results conformed with the findings of [12] and [14] for earliness traits.

The next best heterotic cross identified in the present study was Kadir-6 x CS-19 as it recorded higher magnitude of heterosis for number of pods plant^{-1} (sick:12.02%; control:8.77%), number of immature pods plant^{-1} (sick:-58.08%; control:-32.94%), number of mature pods plant^{-1} (sick:22.03%; control:15.44%), dry haulm weight plant^{-1} (sick:53.49% ;control:39.89%), pod yield plant^{-1} (sick:30.05%; control:9.08%), kernel yield plant^{-1} (sick:26.48%; control:10.43%) percent disease incidence at maturity (sick:-85.14% ;control:-99.86%) and protein content (%) (control:7.03%).

The F_1 cross ICGV-07262 x TCGS-1862 recorded desirable heterosis for SCMR at 60 DAS (Sick: 9.57%; control:3.98%), number of pods plant^{-1} (sick:9.05%; control:10.82%), dry haulm weight plant^{-1} (sick:24.12%; control:8.36%), pod yield plant^{-1} (sick:56.06%; control:12.66%), percent disease incidence at maturity (sick:-73.45%; control:0.00%) and number of primary branches plant^{-1} (Sick: 32.65%.). Another heterotic cross ICGV-07262 x TCGS-2149 displayed desirable better-parent heterosis for number of flowers plant^{-1} (sick:6.99%; control:6.30%), sound mature kernel % (sick:7.35%; control:4.10%), dry haulm weight plant^{-1} (sick:73.63%; control:50.25%), pod yield plant^{-1} (sick:17.07%; control:2.36%), kernel yield plant^{-1} (sick:57.75%; control:10.29%), percent disease incidence at maturity (sick:-70.69%; control:0.00 %), number of primary branches plant^{-1} (sick:75%), number of flowers per plant^{-1} (Sick:6.99%) and shelling per cent (sick: 31.51%).Similarly, the crosses *viz.*, ICGV-07262 x J-11 and Kadiri-6 x J-11 were reported as a best heterotic cross for hundred pod weight (sick: 27.51%) and number of secondary branches plant^{-1} (sick: 45.45%), respectively. Additionally, the crosses viz., Kadiri-6 x J-11(45.45%) and Kadiri-6 x CS-19 (28.12%) for a number of secondary branches plant^{-1} and Narayani x TCGS-1862 (15.74%) revealed better parent heterosis in sick plot condition. Six crosses *viz.*, ICGV-07262 x CS-19 (12.05%), ICGV-91114 x TCGS-1862 (9.50%), TAG-24 x TCGS-2149 (9.15%), TAG-24 x CS-19 (7.11%), Narayani x CS-19 (6.26%) and Kadiri-6 x TCGS-1862 (5.77%) in control condition noticed the better parent heterosis for harvest index suggesting that these crosses could be utilized for development of high yielding groundnut varieties through intermating followed by meticulous selection in later generation. Likewise, two crosses *viz*., ICGV-91114 x TCGS-1862 (-26.67%) and ICGV-91114 x TCGS-2149 (-24.87%) registered desirable negative heterosis for plant height in the control condition.

A similar kind of positive and significantly better-parent heterosis was also reported in the studies of [11] and [18] for sound mature kernel %, [12] for a number of pods plant^{-1}, dry haulm weight plant^{-1}, pod yield and kernel yield plant^{-1} and [13] for number of mature pods plant^{-1}. The results were in conformity with the findings of [14] for the number of pegs, number of podsplant^{-1}, pod yield and kernel yield plant^{-1}. From the current and previous studies, it is evident that better parent heterosis for yield and yield attributes are the resultant of over-dominant effects.

3.3 Standard-heterosis

Standard-heterosis is of direct practical value in plant breeding in the identification of superior genotypes for commercial release. The cross Narayani x J-11 registered positive and significant standard-heterosis for number of flowers plant^{-1} (sick:43.53%; control:42.61%), number of pegs plant^{-1} (sick:27.94%; control:58.73%), number of pods plant^{-1} (sick:12.26%; control:18.52%), number of mature pods plant^{-1} (sick:10.16%; control:29.03%), sound mature kernel % (sick:4.45%; control:5.43%), dry haulm weight plant^{-1} (sick:49.30%;control:50.04%), pod yield plant^{-1} (sick:29.44%; control:14.91%), kernel yield plant^{-1} (sick:67.07%; control:10.60%), percent disease incidence at maturity (sick:-78.00%;control:-100.00%), 100 pod weight (control:11.41%), 100 kernel weight (sick:7.91%) and shelling per cent (22.76%).

The cross Kadir-6 x CS-19 recorded higher magnitude of heterosis for number of pods plant^{-1} (sick:12.02%; control:8.77%), number of immature pods plant^{-1} (sick:-58.08%; control:-27.85%), number of mature pods plant^{-1}(sick:22.03%; control:15.44%), dry haulm weight plant^{-1} (sick:53.49%;control:52.72%), pod yield plant^{-1} (sick:30.05%; control:9.40%), kernel yield plant^{-1} (sick:52.44%; control:18.64%), percent disease incidence at maturity (sick:-85.14% ;control:-100.00%), 100 pod weight (control: 11.94%) and shelling per cent (sick:17.60%).

The cross ICGV-07262 x TCGS-1862 displayed desirable heterosis for SCMR at 60 DAS (Sick: 3.58% ; control:13.37%), number of pods plant^{-1} (sick:18.75%; control:13.84%), dry haulm weight plant^{-1} (sick:71.16%;control:74.53%), pod yield plant^{-1} (sick:39.17%; control:19.54%), percent disease incidence at maturity (sick:-78.00% ;control:-100.00%), number of primary branches plant^{-1} (sick:44.44%), number of pegs plant^{-1} (control:53.97%) and 100 pod weight (control:9.08%).

Another heterotic cross ICGV-07262 x TCGS-2149 registered desirable standard heterosis for number of flowers plant^{-1} (sick:44.12%; control:43.75%), sound mature kernel % (sick:5.63%;control:6.30%), dry haulm weight plant^{-1}

(sick:64.74%;control:62.42%), pod yield plant^{-1} (sick:31.27%; control:12.92%), kernel yield plant^{-1} (sick:65.45%; control:20.08%), percent disease incidence at maturity (sick:-75.71% ;control:-100.00 %), number of primary branches plant^{-1} (sick:40.00%), number of pegsplant^{-1} (control:59.26%), 100 pod weight (control:10.06%) and shelling per cent (sick:25.99%).

Four crosses in sick plot condition and nine crosses in the control condition were found as best heterotic crosses for harvest index. Desirable negative heterosis of -14.32% for plant height was recorded in the cross TAG-24 x TCGS-1862 in sick plot condition where as seven crosses *viz.*, Kadir-6 x TCGS-1862 (122.22%),Kadir-6 x TCGS-2149 (94.44%), Kadir-6 x J-11 (122.22%),Kadir-6 x CS-19 (222.22%), Narayani x TCGS-1862 (166.67%), Narayani x TCGS-2149 (127.78%) and Narayani x TCGS-CS-19 (105.56%) over Kadiri-6 revealed desirable heterosis for number of secondary branches plant^{-1} in control condition.

Further, it was also observed that all the crosses registered desirable standard heterosis for a number of flowers plant^{-1} in both the conditions, hence these crosses could be exploited to develop reproductive efficient groundnut genotypes through rigorous selection in later generations. Four crosses *viz.*, Narayani x J-11, Kadiri-6 x CS-19, ICGV-07262 x TCGS-1862, and ICGV-07262 x TCGS-2149 were identified as superior heterotic crosses in order to isolate genotypes with high water use efficiency in view of their positive standard heterosis for SCMR at 60 DAS and negative standard heterosis for SLA at 60 DAS in control condition.

A similar kind of desirable standard heterosis was also documented by [17] for a number of pods plant^{-1} and pod yield plant^{-1} and [13] reported the positive and significant standard heterosis for a number of mature pods plant^{-1}, pod yield plant^{-1} and kernel yield plant^{-1}.

From the above results it is to conclude that four crosses *viz.*, Narayani x J-11, Kadiri-6 x CS-19, ICGV-07262 x TCGS-1862, and ICGV-07262 x TCGS-2149 in both the conditions were found to be the reservoir for the majority of yield and yield attributing traits which displayed desirable heterosis were governed by dominant alleles and heterosis in F_1s was a result of dominant and over-dominant gene effects. Hence these traits are advanced for direct selection to enhance vigor gain.

The high magnitude of heterosis was observed for most of the traits in all the crosses indicating the role of non-additive gene action in their expression. Based on the results of mean performance, combining ability and heterosis in sick plot and control condition the crosses *viz.*, Kadiri-6 x CS-19, Narayani x J-11, ICGV-07262 x TCGS-1862 and ICGV-07262 x TCGS-2149 were considered as worthy combinations for enhancing pod yield coupled with stem rot resistance in groundnut.

With respect to combining ability effects and heterosis, the following broad inferences could be drawn from the present study *i.e.,*the crosses exhibiting high heterosis with desirable *SCA* effects did not always involve parents with high *GCA* effects, thereby suggesting the importance of interallelic interactions. However, it was also observed that at least one good general combiner was involved in best-performing cross combinations. Thus, the potentiality of a genotype to be used as a parent in hybridization, or a cross to be used for recombination breeding may be judged by comparing *perse* performance of parents and crosses, along with combining ability effects of parents and heterotic response of crosses.

Conclusion

The cross, ICGV-07262 x TCGS-1862 was identified as the best heterotic cross for pod yield plant^{-1} and its components and the predominance of over-dominance effects was observed for yield and its components over standard resistant tester J-11 to the extent of 39.17% in sick plot condition and over standard line Kadiri-6 to the extent of 19.54% in control condition, respectively. The crosses *viz.,* Narayani x J-11, Kadiri-6 x CS-19, ICGV-07262 x TCGS-1862, and ICGV-07262 x TCGS-2149 were identified as best cross combinations for both yield and stem rot resistance.

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Table 1: Salient features of the parents used for the hybridization programme in groundnut

S. No	Genotype	Parentage	Botanical type	Days to maturity	Yield (q ha^{-1})	Released from	Salient features
Lines							
1.	Kadiri-6	JL-24 x Ah316/S	Spanish bunch	90-100	18-20	ARS, Kadiri	Suitable for both *kharif* and *rabi* seasons, susceptible to rust, LLS and stem rot.
2.	Narayani	JL-24 x Ah316/S	Spanish bunch	90-100	20	RARS, Tirupai	High yielding, drought tolerant and early maturity variety and susceptible to rust, LLS and stem rot.
3.	TAG-24	TGS-2 × TGE-1	Spanish bunch	75-80	12-15	BARC, Trombay	High yielding, widely adapted national check, susceptible to LLS, rust and stem rot
4.	ICGV-07262	[(ICGV 92069 x ICGV- 93184) SIL4 x (ICGS-44 x ICGS-76)]	Spanish bunch	95-100	13	ICRISAT	High yielding, medium duration variety, drought tolerant, susceptible to stem rot.
5.	ICGV-91114	(ICGV-86055 x ICGV-86533)	Spanish bunch	90	12-14	ICRISAT	High yielding, early maturing variety, drought tolerant and susceptible to stem rot.

Testers							
1	TCGS-1862	KDG-128 x NTCG-CS-425	Spanish bunch	120	12	RARS, Tirupati	High yielding, early to medium duration variety with stay green nature and tolerant to stem rot.
2	TCGS-2149	Greeshma x ICGV-91114	Spanish bunch	110-115	14	RARS, Tirupati	Medium duration variety tolerant to stem rot.
3	J-11	Ah 4218 x AL 4354	Virginia bunch	110-115	13	ICAR-DGR, Gujarat	High yielding, wider adaptability, suitable to summer and tolerant to stem rot, collar rot and aflotoxin.
4	CS-19	TMV 2 x *A. Chacoense*	Spanish bunch	115-20	14	ICAR-DGR, Gujarat	High yielding variety with tolerant to stem rot, collar rot.

Table 2: Percent mid parent heterosis (MH), better parent heterosis (BH) and standard heterosis (SH) for Days to 50% flowering and Days to maturity in groundnut

S.No.	Crosses	Days to 50% flowering						Days to maturity					
		Sick			Control			Sick			Control		
		MH	BH	SH	MH	BH	SH	MH	BH	SH	MH	BH	SH
1	Kadiri-6 x TCGS-1862	-4.55	-8.70 *	0.00	-7.94	-12.12 *	-12.12 *	-1.36	-1.80	-1.80	-0.89	-6.72 *	5.71
2	Kadiri-6 x TCGS-2149	-3.17	-3.17	-3.17	-8.33	-16.67 **	-16.67 **	-0.45	-0.89	0.00	2.29	-1.33	6.19
3	Kadiri-6 x J-11	0.79	0.00	1.59	-4.76	-9.09	-9.09	-4.72 **	-4.93 *	-4.50*	2.97	-0.88	7.14 *
4	Kadiri-6 x CS-19	-0.78	-3.03	1.59	7.69	-4.55	-4.55	0.23	-1.35	-1.35	2.73	-1.74	7.62 *
5	Narayani x TCGS-1862	-6.15	-11.59 **	-3.17	1.72	-1.67	-10.61 *	0.69	0.00	-090	-2.75	-10.92 **	0.95
6	Narayani x TCGS-2149	0.00	-1.59	-1.59	3.64	1.79	-13.64 *	-2.49	-4.02 *	-3.15	0.00	-6.19 *	0.95
7	Narayani x J-11	-4.00	-6.25	-4.76	-3.45	-6.67	-15.15 **	0.45	-0.90	0.45	-4.47	-10.57 **	-3.33
8	Narayani x CS-19	-0.79	-4.55	0.00	2.80	-1.79	-16.67 **	0.00	-0.46	-2.70	0.47	-6.52 *	2.38
9	TAG-24 x TCGS-1862	-2.26	-5.80	3.17	-3.17	-7.58	-7.58	-0.90	-2.21	-0.45	-5.70 *	-9.66 **	2.38
10	TAG-24 x TCGS-2149	0.79	0.00	1.59	-6.67	-15.15 **	-15.15 **	-5.78 **	-6.19 **	-4.50*	-1.35	-3.10	4.29
11	TAG-24 x J-11	0.00	0.00	1.59	-7.94	-12.12 *	-12.12 *	-3.34 *	-3.98 *	-2.25	-2.47	-4.41	3.33
12	TAG-24 x CS-19	-4.62	-6.06	-1.59	-0.85	-12.12 *	-12.12 *	0.23	-2.21	-0.45	-2.23	-4.78	4.29
13	ICGV-07262 x TCGS-1862	0.00	-8.70 *	0.00	-6.56	-8.06	-13.64 *	0.22	-2.58	-2.25	-3.46	-6.30 *	6.19
14	ICGV-07262 x TCGS-2149	1.67	-3.17	-3.17	15.52**	8.06	1.52	-4.60 **	-6.44 **	-0.45	0.44	0.00	7.62 *
15	ICGV-07262 x J-11	2.48	-3.13	-1.59	9.84 *	8.06	1.52	-2.19	-4.29 *	2.25	-2.88	-3.52	4.29
16	ICGV-07262 x CS-19	4.07	-3.03	1.59	4.42	-4.84	-10.61 *	-2.68	-6.44 **	-1.80	1.76	0.43	10.00 **
17	ICGV-91114 x TCGS-1862	-8.06 *	-17.39 **	-9.52*	7.69	5.00	-4.55	-2.21	-9.55 **	-10.36	-1.73	-4.62	8.10 *

18	ICGV-91114 x TCGS-2149	-8.47*	-14.29**	-14.29**	13.51 *	10.53	-4.55	-3.16	-11.16**	-10.36**	2.22	1.77	9.52**
19	ICGV-91114 x J-11	-5.88	-12.50**	-11.11**	7.69	5.00	-4.55	-0.49	-8.52**	-8.11**	-0.67	-1.32	6.67*
20	ICGV-91114 x CS-19	-4.13	-12.12**	-7.94*	14.81 **	8.77	-6.06	4.98**	-1.86	-4.95**	-8.37**	-9.57**	-0.95
SE (Heterosis)		0.96	1.11	1.11	1.37	1.58	1.58	1.69	1.95	1.95	2.78	3.21	3.21

Table 3: Percent mid parent heterosis (MH), better parent heterosis (BH) and standard heterosis (SH) for SCMR at 60 DAS and SLA at 60 DAS ($cm^2\ g^{-1}$) in groundnut

S. No.	Crosses	SCMR at 60 DAS						SLA at 60 DAS ($cm^2\ g^{-1}$)					
		Sick			Control			Sick			Control		
		MH	BH	SH	MH	BH	SH	MH	BH	SH	MH	BH	SH
1	Kadiri-6 x TCGS-1862	1.67	-1.34	-1.34	-0.24	-0.72	0.24	-13.15*	-19.35**	-19.35**	-21.42**	-20.00**	-22.79**
2	Kadiri-6 x TCGS-2149	3.99	-0.66	-0.66	-3.26*	-3.37*	-3.37*	-22.81**	-23.02**	-23.02**	-32.27**	-36.38**	-27.59**
3	Kadiri-6 x J-11	0.00	-0.45	-0.45	-3.71**	-4.29**	-3.13*	-15.16**	-19.54**	-10.28	-17.34**	-18.43**	-16.22**
4	Kadiri-6 x CS-19	5.61*	3.13	3.13	5.65**	3.34 *	8.07**	28.52**	28.14**	28.90**	-26.00**	-30.93**	-20.31**
5	Narayani x TCGS- 1862	1.65	0.70	-3.46	-1.00	-2.32	1.33	-16.85**	-22.23**	-23.41**	-8.94*	-15.83**	-18.76**
6	Narayani x TCGS-2149	-15.30**	-17.42**	-20.84**	-1.95	-3.83**	-0.24	-24.08**	-24.45**	-24.86**	-39.77**	-48.21**	-41.06**
7	Narayani x J-11	3.38	1.69	0.78	12.40**	11.03**	15.18**	-14.43**	-19.42**	-10.15	-16.79**	-25.21**	-23.19**
8	Narayani x CS-19	-5.67*	-5.94*	-9.83**	-1.56	-1.96	2.53	-13.80**	-14.70*	-14.19*	-19.92**	-31.54**	-21.01**
9	TAG-24 x TCGS-1862	-1.25	-1.78	-7.60**	-1.77	-3.70*	-2.77	1.95	-0.04	-10.82	-21.29**	-21.70**	-24.42**
10	TAG-24 x TCGS-2149	-0.73	-1.80	-8.60**	0.67	-0.72	-0.96	-15.04**	-19.41**	-19.85**	-29.28**	-34.96**	-25.98**
11	TAG-24 x J-11	-17.09**	-19.62**	-20.34**	2.49*	0.36	1.57	-35.35**	-41.81**	-35.12**	-38.51**	-40.65**	-39.05**
12	TAG-24 x CS-19	-3.35	-4.48	-8.96**	2.21	-1.50	3.01*	4.59	-1.32	-0.74	-26.94**	-33.23**	-22.96**
13	ICGV-07262 x TCGS-1862	9.83**	9.57**	3.58	7.97**	3.98**	13.37**	31.71**	10.74	-5.06	-18.21**	-26.20**	-28.77**
14	ICGV-07262 x TCGS-2149	13.18**	11.11**	5.03	8.60**	3.98**	13.37**	3.99	-17.46**	-17.91**	-23.90**	-35.98**	-27.14**
15	ICGV-07262 x J-11	-1.10	-3.38	-4.25	-2.92*	-6.41**	2.05	-3.34	-26.34**	-17.87**	-14.04**	-24.51**	-22.47**
16	ICGV-07262 x CS-19	0.65	0.23	-4.47	-5.47**	-7.40**	0.96	-24.49**	-40.32**	-39.96**	-27.66**	-39.48**	-30.17**
17	ICGV-91114 x TCGS-1862	4.92*	3.80	-2.35	2.33	-0.60	0.36	-16.61**	-18.26**	-27.03**	-17.37**	-17.29**	-20.17**

18	ICGV-91114 x TCGS-2149	-1.77	-2.31	-10.06**	4.94**	2.54	2.29	-16.14**	-20.43**	-20.86**	-22.12**	-27.97**	-18.02**
19	ICGV-91114 x J-11	-6.25*	-9.58**	-10.39**	-0.98	-3.93**	-2.77	-2.75	-12.45*	-2.38	-26.88**	-29.01**	-27.09**
20	ICGV-91114 x CS-19	1.97	0.23	-4.47**	0.72	-3.80**	0.60	-15.21**	-19.98**	-19.50**	-27.50**	-33.37**	-23.13**
SE (Heterosis)		0.95	1.10	2.86	0.48	0.56	0.56	6.60	7.62	7.62	9.24	10.67	10.67

Table 4: Percent mid parent heterosis (MH), better parent heterosis (BH) and standard heterosis (SH) for Harvest index (%) and Plant height (cm) in groundnut

S. No.	Crosses	Harvest index (%)						Plant height (cm)					
		Sick			Control			Sick			Control		
		MH	BH	SH	MH	BH	SH	MH	BH	SH	MH	BH	SH
1	Kadiri-6 x TCGS-1862	-9.24**	-13.37**	-4.70**	8.26**	5.77*	5.77*	21.80**	19.66**	19.66**	53.73**	52.33**	55.15**
2	Kadiri-6 x TCGS-2149	-5.66**	-8.06**	-3.12*	1.17	0.64	0.64	-0.87	-2.67	-2.67	8.65	0.90	17.68
3	Kadiri-6 x J-11	-12.24**	-15.48**	-8.74**	2.15	1.61	2.70	24.37**	18.93**	18.93**	16.81	9.17	25.59
4	Kadiri-6 x CS-19	-9.84**	-12.77**	-6.71**	-11.00**	-12.36**	-12.36**	12.94**	10.19*	10.19 *	5.67	-2.67	15.57
5	Narayani x TCGS- 1862	-21.71**	-22.62**	-14.86**	8.20**	5.14*	6.31**	16.18**	13.73**	14.56**	27.16*	17.10	19.26
6	Narayani x TCGS-2149	-5.70**	-6.62**	0.35	8.00**	6.86**	8.04**	-5.42	-7.47	-6.80	2.75	-10.86	3.96
7	Narayani x J-11	-12.48**	-12.69**	-5.72**	-10.80**	-10.81**	-9.82**	9.36*	4.22	4.98	3.56	-9.63	3.96
8	Narayani x CS-19	-15.26**	-15.46**	-9.15**	8.49**	6.26**	7.44**	-0.12	-2.89	-2.18	22.85*	5.78	25.59
9	TAG-24 x TCGS-1862	-1.17	-1.28	8.86**	4.60*	1.12	3.35	1.22	-11.19*	-14.32**	20.74	17.62	19.79
10	TAG-24 x TCGS-2149	2.38*	0.10	10.39**	10.91**	9.15**	11.55**	13.63**	-0.25	-3.88	13.86	4.07	21.37
11	TAG-24 x J-11	-7.24**	-8.21**	1.22	3.73*	3.16	5.43*	26.04**	13.30*	3.40	22.19*	12.39	29.29 *
12	TAG-24 x CS-19	-16.41**	-17.67**	-9.21**	9.94**	7.11**	9.46**	18.79**	4.85	-0.24	20.59	9.33	29.82 *
13	ICGV-07262 x TCGS-1862	-15.31**	-16.68**	-8.33**	-12.37**	-14.68**	-14.07**	26.15**	22.26**	17.96	23.42*	18.29	31.40 *
14	ICGV-07262 x TCGS-2149	-14.23**	-14.67**	-9.16**	-13.36**	-14.11**	-13.50**	21.56**	17.88**	13.59	22.83*	19.91	39.84**
15	ICGV-07262 x J-11	-24.92**	-25.45**	-19.50**	-0.18	-0.36	0.71	11.62*	11.17*	1.46	12.49	10.55	27.18 *
16	ICGV-07262 x CS-19	-12.17**	-12.37**	-6.28**	14.19**	12.05**	12.85**	21.31**	18.37**	12.62**	5.63	2.22	21.37
17	ICGV-91114 x TCGS-1862	-12.76**	-14.99**	-6.47**	13.65**	9.50**	12.70**	-1.58	-5.79	-9.10	-26.29*	-26.67*	-24.54
18	ICGV-91114 x TCGS-2149	-1.92	-2.37	2.87*	1.93	-0.02	2.90	9.93*	5.29	1.46	-20.19	-24.89*	-12.40
19	ICGV-91114 x J-11	1.17	-0.51	7.43**	-4.44*	-5.29*	-2.53	-4.80	-6.38	-14.56**	-2.18	-7.34	6.60
20	ICGV-91114 x CS-19	-10.29**	-11.36**	-5.20**	-14.55**	-17.03**	-14.61**	-3.88	-7.37	-11.97	-2.40	-8.91	8.15
SE (Heterosis)		0.71	0.83	0.83	1.14	1.32	1.32	1.60	1.85	1.85	2.10	2.43	2.43

Table 5: Percent mid parent heterosis (MH), better parent heterosis (BH) and standard heterosis (SH) for Number of primary branches plant^{-1} and Number of secondary branches plant^{-1} in groundnut

S. No.	Crosses	No. of primary branches plant^{-1}						No. of secondary branches plant^{-1}					
		Sick			Control			Sick			Control		
		MH	BH	SH	MH	BH	SH	MH	BH	SH	MH	BH	SH
1	Kadiri-6 x TCGS-1862	-2.13	-6.12	2.22	-1.85	-20.90*	29.27	1.69	0.00	0.00	247.83**	122.22**	122.22**
2	Kadiri-6 x TCGS-2149	11.11	0.00	0.00	-2.86	-20.31	24.39	-36.17*	-53.13**	0.00	25.00	-7.89	94.44*
3	Kadiri-6 x J-11	-23.86*	-25.56	-25.56*	-5.64	-18.58	12.20	72.97**	45.45*	113.33	11.53**	100.00	122.22**
4	Kadiri-6 x CS-19	-34.00**	-40.00**	-26.67*	47.98**	40.66*	56.10**	74.47**	28.12*	173.33	100.00**	45.00*	222.22**
5	Narayani x TCGS-1862	-5.49	-12.24	-4.44	-20.00*	-25.37*	21.95	48.45**	5.88	140.00	95.92**	9.09	166.67**
6	Narayani x TCGS-2149	-2.56	-9.52	-15.56	-22.95*	-26.56*	14.63	18.18	14.71	160.00	0.00	-6.82	127.78**
7	Narayani x J-11	-1.18	-2.33	-6.67	-21.40*	-22.41	9.76	-46.43**	-55.88**	0.00	-6.25	-31.82	66.67
8	Narayani x CS-19	0.00	-11.82	7.78	-14.98	-24.14*	7.32	-54.55**	-55.88**	0.00	-11.90	-15.91	105.56*
9	TAG-24 x TCGS-1862	24.22	2.04	11.11	-14.52	-20.90*	29.27	-60.40**	-72.22**	-33.33	-5.66	-47.92**	38.89
10	TAG-24 x TCGS-2149	9.63	2.78	-17.78	-25.62*	-29.69**	9.76	-11.76	-16.67	100.00	-27.91	-35.42*	72.22
11	TAG-24 x J-11	-16.78	-27.91*	-31.11*	-21.59*	-21.93	8.54	-31.03**	-44.44**	33.33	-11.76	-37.50*	66.67
12	TAG-24 x CS-19	6.36	-16.36	2.22	-9.27	-18.42	13.41	-55.88**	-58.33**	0.00	-45.45**	-50.00**	33.33
13	ICGV-07262 x TCGS-1862	57.58**	32.65**	44.44**	-26.87*	-38.06**	1.22	-57.45**	-69.23**	-33.33	50.00	-14.29	66.67
14	ICGV-07262 x TCGS-2149	81.29**	75.00**	40.00**	-31.22**	-40.62**	-7.32	-53.49**	-53.85**	0.00	-17.81	-21.05	66.67
15	ICGV-07262 x J-11	16.34	3.49	-1.11	-25.24*	-31.86*	-6.10	-26.61	-38.46**	33.33	-27.27	-42.86	11.11
16	ICGV-07262 x CS-19	25.42*	0.91	23.33	-8.70	-9.68	2.44	-68.99**	-69.23**	-33.33	-38.67*	-42.05*	22.78
17	ICGV-91114 x TCGS-1862	-18.95	-21.43	-14.44	-3.08	-5.97	53.66**	-41.18**	-58.90**	0.00	11.11	-38.78*	66.67
18	ICGV-91114 x TCGS-2149	41.46**	26.09*	28.89*	-14.17	-14.84	32.93	-56.20**	-58.90**	0.00	-49.43**	-55.10**	22.22
19	ICGV-91114 x J-11	-17.98	-20.65	-18.89*	8.79	3.17	58.54**	-48.72**	-58.90**	0.00	-36.23	-55.10**	22.22
20	ICGV-91114 x CS-19	-22.77*	-29.09**	-13.33	-18.89	-25.37*	21.95	-70.80**	-72.60**	-33.33	-32.58*	-38.78*	66.67
SE (Heterosis)		0.47	0.55	0.55	0.57	0.66	0.66	0.36	0.42	0.42	0.32	0.37	0.37

Table 6: Percent mid parent heterosis (MH), better parent heterosis (BH) and standard heterosis (SH) for Number of flowers plant^{-1} from 25 to 50 DAS and Number of pegs plant^{-1} in groundnut

S. No.	Crosses	No. of flowers plant^{-1} from 25 to 50 DAS						No. of pegs plant^{-1}					
		Sick			Control			Sick			Control		
		MH	BH	SH	MH	BH	SH	MH	BH	SH	MH	BH	SH
1	Kadiri-6 x TCGS-1862	-1.30	-11.63**	11.76**	3.31	-6.45 *	15.34 **	12.20	6.45	6.45	-12.24 *	-15.27 *	-8.99
2	Kadiri-6 x TCGS-2149	10.88 **	-0.93	25.88**	10.84 **	-2.17	27.84 **	-17.03	-22.13 *	-22.13*	-21.87 **	-26.91 **	-16.08 *
3	Kadiri-6 x J-11	6.91 **	-5.43*	22.94**	7.62 **	-5.19 *	24.43 **	16.35	15.82	16.89	-7.57	-7.57	-7.57
4	Kadiri-6 x CS-19	14.29 **	-0.44	34.12**	11.44 **	-2.55	30.11 **	-31.26 **	-32.10 **	-30.39**	57.25 **	51.47 **	63.49 **
5	Narayani x TCGS-1862	19.38 **	7.44 **	35.88**	21.21 **	10.60 **	36.36 **	-6.15	-11.58	-20.65	-3.23	-4.19	2.91
6	Narayani x TCGS-2149	21.65 **	9.26 **	38.82**	17.85 **	4.78 *	36.93 **	12.50	7.14	-6.03	-22.84 **	-26.04 **	-15.08 *
7	Narayani x J-11	24.17 **	10.41 **	43.53**	22.44 **	8.66 **	42.61 **	41.93 **	26.76 *	27.94*	54.64 **	50.75 **	58.73 **
8	Narayani x CS-19	17.21 **	2.62	38.24**	15.94 **	2.13	36.36 **	36.23 **	20.85	23.87*	-20.55 **	-21.52 **	-15.29 *
9	TAG-24 x TCGS-1862	2.08	-8.84 **	15.29**	3.36	-7.83 **	13.64 **	22.91	11.66	0.21	-17.46 **	-25.02 **	-19.47 **
10	TAG-24 x TCGS-2149	4.94 *	-6.48 **	18.82**	-1.00	-13.91 **	12.50 **	14.99	5.56	-7.42	-18.03 **	-27.70 **	-16.98 *
11	TAG-24 x J-11	-1.54	-13.12 **	12.94**	-0.25	-13.42 **	13.64 **	-27.03 *	-37.01 **	-36.43**	-2.54	-8.52	-8.52
12	TAG-24 x CS-19	4.02 *	-9.61 **	21.76**	1.73	-12.34 **	17.05 **	15.62	-0.84	1.65	-12.22 *	-20.44 **	-14.13 *
13	ICGV-07262 x TCGS-1862	6.31 **	3.06	38.82**	4.62 *	0.00	35.23 **	36.13 **	31.59 *	18.10	50.00 **	43.35 **	53.97 **
14	ICGV-07262 x TCGS-2149	10.11 **	6.99 **	44.12**	8.12 **	6.30 **	43.75 **	22.33 *	19.58	4.87	49.75 **	38.71 **	59.26 **
15	ICGV-07262 x J-11	4.44 *	2.62	38.24**	4.05 *	2.52	38.64 **	15.08	5.29	6.26	-18.24 **	-19.10 **	-19.10 **
16	ICGV-07262 x CS-19	10.48 **	10.48 **	48.82**	9.51 **	8.82 **	47.16 **	37.02 **	24.49 *	27.61*	-13.11 *	-17.16 *	-10.58
17	ICGV-91114 x TCGS-1862	13.38 **	10.62 **	47.06**	12.64 **	8.55 **	44.32 **	14.71	8.07	-3.02	-10.17	-21.67 **	-15.87 *
18	ICGV-91114 x TCGS-2149	10.86 **	8.41 **	44.12**	10.34 **	9.40 **	45.45 **	42.78 **	35.98 **	19.26	-21.30 **	-33.27 **	-23.39 **
19	ICGV-91114 x J-11	8.72 **	7.52 **	42.94**	7.96 **	7.26 **	42.61 **	-16.71	-25.61 *	-24.92*	-10.82	-19.79 **	-19.79 **
20	ICGV-91114 x CS-19	2.42	1.75	37.06**	3.20	2.98	37.50 **	-22.99 *	-31.69 **	-29.98**	-19.55 **	-30.00 **	-24.44 **
SE (Heterosis)		1.85	2.13	2.13	2.25	2.60	2.60	1.94	2.24	2.24	0.53	0.61	0.61

Table 7: Percentmid parent heterosis (MH), better parent heterosis (BH) and standard heterosis (SH) for Number of pods plant^{-1} and Number of immature pods plant^{-1} in groundnut

S. No.	Crosses	No. of pods plant^{-1}						No. of immature pods plant^{-1}					
		Sick			Control			Sick			Control		
		MH	BH	SH	MH	BH	SH	MH	BH	SH	MH	BH	SH
1	Kadiri-6 x TCGS-1862	-14.84**	-18.32**	-11.06**	-13.59**	-17.54**	-17.54**	44.44**	25.00 *	25.00*	-20.75*	-46.84**	-46.84**
2	Kadiri-6 x TCGS-2149	-23.41**	-27.37**	-18.99**	-8.18*	-17.93**	-17.93**	63.41**	28.85**	28.85**	15.32	-18.99*	-18.99*
3	Kadiri-6 x J-11	-18.41**	-21.15**	-21.15**	-1.32	-12.48**	-12.48**	6.82	-9.62	-9.65	11.11	-17.72*	-17.72*
4	Kadiri-6 x CS-19	13.11**	12.02**	12.02**	16.25**	8.77*	8.77 *	-55.96**	-58.08**	-58.08**	-30.49**	-32.94**	-27.85**
5	Narayani x TCGS-1862	-27.95**	-35.98**	-30.29**	-4.12	-5.15	-13.84**	9.68	-10.53	-34.62**	13.64	-18.03	-36.71**
6	Narayani x TCGS-2149	-32.60**	-40.73**	-33.89**	0.47	-5.26	-15.79**	118.52**	96.67**	13.46	-7.53	-29.51**	-45.57**
7	Narayani x J-11	26.22**	20.36**	12.26**	42.56**	33.33**	18.52**	120.00**	83.33**	26.92**	-3.03	-21.31*	-39.24**
8	Narayani x CS-19	-11.84**	-17.89**	-19.47**	-22.48**	-23.25**	-31.77**	142.25**	82.98**	65.38**	-50.68**	-57.65**	-54.43**
9	TAG-24 x TCGS-1862	-14.43**	-26.71**	-20.19**	8.31*	-2.15	-11.11**	-25.37	-34.21*	-51.92**	-8.43	-32.14**	-51.90**
10	TAG-24 x TCGS-2149	-18.68**	-31.03**	-23.08**	0.00	-3.47	-23.98**	34.24 *	32.00	-23.85	-4.55	-25.00*	-46.84**
11	TAG-24 x J-11	-20.68**	-27.32**	-32.21**	-5.30	-7.81	-28.65**	29.23 *	16.67	-19.23	-12.77	-26.79*	-48.10**
12	TAG-24 x CS-19	-10.81**	-20.10**	-21.63**	0.36	-7.61	-19.49**	23.68 *	0.00	-9.62	-57.45**	-64.71**	-62.03**
13	ICGV-07262 x TCGS-1862	26.83**	9.05**	18.75**	17.62**	10.82**	13.84**	142.11**	142.11**	76.92**	47.83**	21.43	-35.44**
14	ICGV-07262 x TCGS-2149	23.04**	4.74	16.83**	42.64**	26.00**	29.43**	102.94**	81.58**	32.69**	37.84 *	21.43	-35.44**
15	ICGV-07262 x J-11	0.28	-7.73*	-13.94**	-6.06	-17.65**	-15.40**	137.84**	131.58**	69.23**	12.50	7.14	-43.04**
16	ICGV-07262 x CS-19	-11.17**	-20.10**	-21.63**	-26.08**	-31.69**	-29.82**	92.94**	74.47**	57.69*	65.35**	23.53**	32.91**
17	ICGV-91114 x TCGS-1862	-15.97**	-26.27**	-19.71**	-27.66**	-34.33**	-40.35**	68.75**	42.11**	3.85	219.35**	182.86**	25.32**
18	ICGV-91114 x TCGS-2149	-25.81**	-35.56**	-28.12**	-11.48**	-14.11**	-32.36**	178.57**	160.00**	50.00**	25.37	20.00	-46.84**
19	ICGV-91114 x J-11	-30.68**	-34.79**	-39.12**	6.05	3.78	-19.69**	61.29**	38.89 *	-3.85	31.51 *	26.32	-39.24**
20	ICGV-91114 x CS-19	-30.40**	-36.03**	-37.26**	-10.76**	-17.45**	-28.07**	-23.29	-40.43**	-46.15**	41.67**	0.00	7.59
SE (Heterosis)		0.56	0.65	0.65**	0.71	0.82	0.82	0.21	0.24	0.24	0.25	0.29	0.29

Table 8: Percent mid parent heterosis (MH), better parent heterosis (BH) and standard heterosis (SH) for Number of matured pods plant^{-1} and 100 pod weight (g) in groundnut

S.No.	Crosses	No. of mature pods plant^{-1}						100 pod weight (g)					
		Sick			Control			Sick			Control		
		MH	BH	SH	MH	BH	SH	MH	BH	SH	MH	BH	SH
1	Kadiri-6 x TCGS-1862	-21.69**	-26.51**	-16.21**	-12.71**	-13.21**	-12.21**	-9.92	-19.95**	-19.95**	-5.28**	-6.42**	-4.11**
2	Kadiri-6 x TCGS-2149	-32.33**	-37.79**	-25.82**	-11.41**	-17.74**	-17.74**	-9.97	-25.20**	-25.20**	-5.45**	-5.58**	-5.32**
3	Kadiri-6 x J-11	-21.51**	-22.80**	-22.80**	-3.15	-11.52**	-11.52**	22.11**	4.68	4.68	-4.91**	-5.40**	-4.42**
4	Kadiri-6 x CS-19	22.54**	22.03**	22.03*	25.88**	15.44**	15.44**	-16.27**	-16.66*	-15.87*	10.81**	9.71**	11.94**
5	Narayani x TCGS-1862	-31.09**	-38.31**	-29.67**	-6.00	-10.71*	-9.68*	15.82*	13.28	-7.90	-3.17**	-3.53**	-1.15
6	Narayani x TCGS-2149	-43.31**	-50.23**	-40.66**	1.43	-1.52	-10.37*	18.08*	7.09	-12.94*	-3.14**	-3.81**	-2.18
7	Narayani x J-11	17.94**	13.92**	10.16**	48.54**	41.77**	29.03**	6.74	0.27	-18.48**	9.91**	9.55**	11.41**
8	Narayani x CS-19	-27.72**	-31.02**	-31.59**	-17.04**	-20.51**	-27.65**	-15.59*	-23.81**	-23.08**	3.44**	3.27**	5.37**
9	TAG-24 x TCGS-1862	-13.40**	-26.02**	-15.66**	10.14*	-4.78	-3.69	-9.45	-11.16	-28.23**	-5.49**	-9.39**	-7.15**
10	TAG-24 x TCGS-2149	-22.97**	-35.39**	-22.97**	0.58	-6.45	-19.82**	6.44	-3.20	-21.80**	1.09	-2.07	-1.80
11	TAG-24 x J-11	-25.70**	-31.82**	-34.07**	-4.27	-9.47	-25.12**	0.24	-5.56	-23.70**	8.85**	5.07**	6.16**
12	TAG-24 x CS-19	-14.81**	-22.71**	-23.35**	12.32**	5.80	-11.75**	-1.55	-11.39	-10.54	-0.94	-4.83**	-2.89*
13	ICGV-07262 x TCGS-1862	14.37**	-3.13	10.44**	15.37**	9.90**	22.81**	0.40	-2.85	-19.26**	5.92**	5.40**	9.08**
14	ICGV-07262 x TCGS-2149	15.51**	-3.92	14.56**	43.06**	26.39**	41.24**	10.82	-0.48	-17.29**	8.02**	6.35**	10.06**
15	ICGV-07262 x J-11	-15.63**	-23.30**	-25.82**	-7.82*	-19.79**	-10.37*	37.12**	27.51**	5.97	-2.86**	-4.01**	-0.66
16	ICGV-07262 x CS-19	-24.81**	-32.41**	-32.97**	-39.79**	-47.42**	-41.24**	-22.88**	-29.69**	-29.02**	-8.84**	-9.48**	-6.32**
17	ICGV-91114 x TCGS-1862	-23.39**	-32.53**	-23.08**	-47.19**	-52.85**	-52.30**	-11.74*	-24.30**	-17.74**	-8.34**	-8.89**	-6.64**
18	ICGV-91114 x TCGS-2149	-41.07**	-49.08**	-39.29**	-14.92**	-18.01**	-29.72**	9.55	-11.88*	-4.24	-7.10**	-7.53**	-6.41**
19	ICGV-91114 x J-11	-39.22**	-42.33**	-44.23**	3.41	1.39	-16.13**	20.25**	-0.34	8.29	-4.81**	-4.89**	-3.73**
20	ICGV-91114 x CS-19	-31.17**	-35.46**	-35.99**	-19.66**	-21.55**	-34.56**	-5.12	-8.49	-0.55	0.52	0.11	2.15
SE (Heterosis)		0.54	0.63	0.63	-32.97	0.83	0.83	6.58	7.60	7.60	1.13	1.30	1.30

Table 9: Percent mid parent heterosis (MH), better parent heterosis (BH) and standard heterosis (SH) for 100 Kernel weight (g) and Sound Mature Kernel % in groundnut

S. No.	Crosses	100 Kernel weight(g)						Sound Mature Kernel %					
		Sick			Control			Sick			Control		
		MH	BH	SH	MH	BH	SH	MH	BH	SH	MH	BH	SH
1	K-6 x TCGS-1862	7.19*	4.53	9.98**	-10.48**	-17.10**	-17.10**	-12.32**	-12.33**	-12.33**	-2.25*	-2.96**	-2.96**
2	K-6 x TCGS-2149	-19.52**	-24.13**	-14.31**	-13.63**	-20.89**	-20.89**	-12.57**	-13.27**	-13.27**	-6.96**	-7.50**	-6.40**
3	K-6 x J-11	-17.31**	-21.25**	-12.95**	-12.68**	-19.90**	-19.90**	-9.90**	-10.42**	-9.37**	-4.21**	-4.72**	-3.69**
4	K-6 x CS-19	2.34	-2.05	7.15	6.74**	2.51	2.51	5.23**	5.20 **	5.26**	1.93*	1.35	2.51*
5	Narayani x TCGS-1862	9.70**	1.61	6.91	-4.36*	-5.46**	-17.54**	-10.45**	-13.82**	-13.79**	-0.73	-2.40*	-0.44
6	Narayani x TCGS-2149	-9.21**	-18.56**	-8.01*	-7.35**	-9.48**	-21.05**	-4.24**	-7.11 **	-8.60**	-5.15**	-5.53**	-3.63**
7	Narayani x J-11	7.78*	-2.38	7.91*	11.80**	9.39**	-4.59**	7.87**	3.25 *	4.45**	3.82**	3.35**	5.43**
8	Narayani x CS-19	-11.19**	-19.19**	-11.60**	-1.49	-4.08*	-11.70**	-3.13*	-6.79 **	-6.74**	-2.70**	-3.12**	-1.17
9	TAG-24 x TCGS-1862	-17.06**	-21.38**	-17.27**	8.01**	-8.87**	-22.35**	-5.66**	-12.02**	-11.99	3.63**	-2.94**	-4.33**
10	TAG-24 x TCGS-2149	-22.16**	-28.59**	-19.35**	7.35**	-8.53**	-23.89**	-2.08	-7.98 **	-9.45**	-1.53	-8.89**	-7.80**
11	TAG-24 x J-11	-15.42**	-21.65**	-13.38**	22.10**	3.90	-13.28**	-4.58**	-11.47**	-10.44**	6.17**	-1.72	-0.66
12	TAG-24 x CS-19	-15.08**	-20.95**	-13.53**	8.01**	-11.63**	-18.65**	-5.80**	-12.16**	-12.11**	3.89**	-3.86**	-2.76**
13	ICGV-07262 x TCGS-1862	6.81*	4.41	9.85*	9.44**	4.55*	-2.17	13.87**	6.71 **	6.74**	1.56	-0.21	1.90
14	ICGV-07262 x TCGS-2149	2.18	-3.46	9.04*	15.12**	8.75**	1.75	13.68**	7.35 **	5.63**	4.57**	4.10**	6.30**
15	ICGV-07262 x J-11	-21.23**	-24.82**	-16.90**	-0.71	-6.07**	-12.11**	-2.47	-9.08 **	-8.02**	-7.46**	-7.92**	-5.98**
16	ICGV-07262 x CS-19	-20.63**	-23.86**	-16.71**	-12.51**	-13.21**	-18.80**	-7.18**	-13.04**	-12.99**	-3.56**	-4.01**	-1.99*
17	ICGV-91114 x TCGS-1862	-2.78	-5.93	-1.02	-0.41	-5.10*	-19.13**	-8.18**	-10.66**	-10.64**	1.43	-1.74	-3.15**
18	ICGV-91114 x TCGS-2149	-22.12**	-27.14**	-17.70**	-3.33	-6.83**	-22.47**	-12.02**	-13.71**	-15.09**	1.83*	-2.58**	-1.42
19	ICGV-91114 x J-11	-12.12**	-16.95**	-8.19*	7.57**	3.53	-13.59**	-12.33**	-15.17**	-14.18**	-3.88**	-8.00**	-7.00**
20	ICGV-91114 x CS-19	-13.67**	-18.00**	-10.30**	-7.31**	-14.79**	-21.55**	-17.00**	-19.25**	-19.25**	-0.85	-5.13**	-4.05**
SE (Heterosis)		1.52	1.76	1.76	0.80	0.93	0.93	0.98	1.13	1.13	0.63	0.73	0.73

Table 10: Percent mid parent heterosis (MH), better parent heterosis (BH) and standard heterosis (SH) for Shelling per cent and Dry haulm weight plant^{-1} (g) in groundnut

S.No.	Crosses	Shelling per cent						Dry haulm weightplant-1(g)					
		Sick			Control			Sick			Control		
		MH	BH	SH	MH	BH	SH	MH	BH	SH	MH	BH	SH
1	K-6 x TCGS-1862	-37.32**	-40.94**	-33.23**	3.18	-0.27	-0.27	15.01**	4.05	4.05	-23.62**	-24.68**	-22.53**
2	K-6 x TCGS-2149	-43.14**	-44.34**	-44.34**	-13.77**	-15.71**	-11.74*	17.27**	5.81*	5.81 *	-7.89	-9.25	-6.50
3	K-6 x J-11	0.19	-9.48	12.18	12.74**	8.42	8.42	35.27**	17.02**	17.02**	-21.80**	-23.24**	-20.30**
4	K-6 x CS-19	8.10	0.02	17.60**	4.71	1.21	8.46	67.94**	53.49**	53.49**	46.02**	39.89**	52.72**
5	Narayani x TCGS-1862	7.26	0.27	13.35*	16.66**	15.74**	8.00	46.78**	43.17**	21.86**	-27.71**	-28.18**	-26.14**
6	Narayani x TCGS-2149	3.77	2.44	0.72	-11.22*	-16.67**	-12.74*	-8.48**	-10.98**	-24.23**	-25.29**	-25.84**	-23.60**
7	Narayani x J-11	10.47*	-0.94	22.76**	4.53	4.25	-3.74	88.82**	75.41**	49.30**	46.14**	44.51**	50.04**
8	Narayani x CS-19	0.50	-7.74	8.48	-4.80	-11.60*	-5.27	38.50**	36.61**	16.28**	-26.75**	-29.32**	-22.84**
9	TAG-24 x TCGS-1862	-14.83**	-16.34**	-5.42	16.42**	11.39*	3.95	0.10	-14.37**	-30.70**	-22.11**	-28.87**	-26.85**
10	TAG-24 x TCGS-2149	-5.00	-10.76	-2.70	-10.43*	-18.75**	-14.91**	-11.02**	-23.70**	-38.60**	-26.83**	-33.23**	-31.21**
11	TAG-24 x J-11	-13.44**	-18.64**	0.83	13.96**	9.60	1.20	24.47**	11.27**	-18.74**	-28.74**	-35.21**	-32.72**
12	TAG-24 x CS-19	-2.83	-6.36	10.10	-22.61**	-30.52**	-25.54**	54.99**	31.35**	8.74**	-26.07**	-34.26**	-28.23**
13	ICGV-07262 x TCGS-1862	7.97	-1.34	11.54	6.89	3.96	2.64	94.71**	80.39**	71.16**	65.47**	61.45**	74.53**
14	ICGV-07262 x TCGS-2149	33.06**	31.51**	25.99**	4.55	1.56	6.35	87.90**	73.63**	64.74**	53.86**	50.25**	62.42**
15	ICGV-07262 x J-11	-18.79**	-28.74**	-11.54	14.95**	11.22*	9.81 *	62.88**	44.12**	36.74**	-24.66**	-26.15**	-20.17**
16	ICGV-07262 x CS-19	-5.76	-15.38**	-0.51	5.15	1.01	8.25	9.63**	2.65	-2.60	-52.62**	-52.85**	-48.53**
17	ICGV-91114 x TCGS-1862	-12.56*	-15.83**	-4.85	-8.08	-13.35*	-19.14**	16.52**	9.83**	-11.12**	-40.25**	-47.14**	-45.64**
18	ICGV-91114 x TCGS-2149	3.46	-0.88	3.66	-23.38**	-31.47**	-28.24**	22.94**	16.18**	-6.51*	-2.37	-13.70*	-11.09*
19	ICGV-91114 x J-11	5.93	-2.34	21.02**	1.09	-4.24	-11.58*	6.75*	5.73	-22.79**	-5.23	-16.51**	-13.31*
20	ICGV-91114 x CS-19	-3.54	-8.87	7.15	-15.64**	-25.30**	-19.95**	14.28**	6.57*	-11.77**	4.04	-10.28*	-2.05
SE (Heterosis)		3.94	4.55	4.55	3.39	3.91	3.91	0.23	0.27	0.27	0.48	0.55	0.55

Table 11: Percent mid parent heterosis (MH), better parent heterosis (BH) and standard heterosis (SH) for Pod yield plant^{-1} (g) and Kernel yield plant^{-1} (g) in groundnut

S. No.	Crosses	Pod yield plant-1 (g)						Kernel yield plant-1 (g)					
		Sick			Control			Sick			Control		
		MH	BH	SH	MH	BH	SH	MH	BH	SH	MH	BH	SH
1	K-6 x TCGS-1862	-9.82**	-12.02**	-7.51*	-4.03*	-8.54**	-8.54**	-43.52**	-47.98**	-38.21**	-1.21	-8.85*	-8.85*

2	K-6 x TCGS-2149	1.72	-2.16	-2.16	-4.96**	-5.01*	-4.90*	-42.20**	-45.53**	-45.53**	-18.05**	-19.95**	-16.06**
3	K-6 x J-11	-0.82	-5.80	-5.80	-16.87**	-19.59**	-13.95**	-0.44	-5.96	5.77	-6.20	-6.75	-6.75
4	K-6 x CS-19	30.67**	30.05**	30.05**	9.24**	9.08**	9.40**	38.25**	26.48**	52.44**	14.39**	10.43**	18.64**
5	Narayani x TCGS-21862149	-18.91**	-19.62**	-15.50**	-9.19**	-15.34**	-11.29**	-13.04**	-19.34**	-4.19	5.99	-0.45	-4.19
6	Narayani x TCGS-2149	-21.85**	-25.98**	-23.55**	-5.66**	-7.75**	-3.35	-19.16**	-24.37**	-23.17**	-16.11**	-19.56**	-15.66**
7	Narayani x J-11	33.98**	25.33**	29.44**	8.52**	7.38**	14.91**	56.10**	48.54**	67.07**	13.40**	11.92**	10.60**
8	Narayani x CS-19	-8.45**	-10.33**	-7.38*	-6.55**	-8.55**	-4.18*	12.45**	3.61	24.88**	-10.86**	-15.51**	-9.22*
9	TAG-24 x TCGS-1862	-3.33	-17.05**	-12.79**	-11.16**	-11.24**	-19.59**	-17.82**	-30.56**	-17.52**	3.50	-1.12	-16.40**
10	TAG-24 x TCGS-2149	-3.95	-12.83**	-19.48**	1.81	-3.12	-3.00	-8.13	-11.53*	-21.71**	-9.23*	-21.29**	-17.47**
11	TAG-24 x J-11	1.43	-6.82*	-16.20**	-20.34**	-26.51**	-21.36**	-13.07**	-24.86**	-15.49**	-9.48*	-19.48**	-20.43**
12	TAG-24 x CS-19	-0.73	-12.64**	-13.46**	-0.89	-5.77**	-5.49**	-5.88	-20.94**	-4.72	-23.68**	-34.49**	-29.62**
13	ICGV-07262 x TCGS-1862	28.11**	24.12**	39.17**	19.00**	8.36**	19.54**	65.76**	56.06**	85.37**	26.84**	12.66**	22.67**
14	ICGV-07262 x TCGS-2149	28.38**	17.07**	31.27**	7.32**	2.36	12.92**	71.12**	57.75**	65.45**	12.37**	10.29**	20.08**
15	ICGV-07262 x J-11	-16.09**	-24.39**	-15.22**	-25.09**	-26.21**	-18.60**	-31.06**	-33.39**	-25.08**	-13.94**	-17.92**	-10.63**
16	ICGV-07262 x CS-19	-21.15**	-25.75**	-16.74**	-28.12**	-31.39**	-24.31**	-26.49**	-31.26**	-17.15**	-24.25**	-24.75**	-18.07**
17	ICGV-91114 x TCGS-1862	-18.40**	-28.09**	-24.40**	-9.80**	-12.22**	-20.47**	-1.30	-15.81**	0.00	-17.14**	-23.89**	-35.65**
18	ICGV-91114 x TCGS-2149	16.59**	8.88**	0.58	3.91 *	-3.56	-3.44	20.99**	17.82**	4.27	-21.16**	-33.97**	-30.77**
19	ICGV-91114 x J-11	10.04**	4.05	-6.41*	-16.30**	-24.63**	-19.34**	15.32**	0.65	13.21**	-15.89**	-27.82**	-28.67**
20	ICGV-91114 x CS-19	-13.53**	-21.78**	-22.52**	-28.78**	-33.95**	-33.76**	-18.77**	-31.13**	-16.99**	-41.01**	-51.07**	-47.43**
SE (Heterosis)		0.40	0.46	0.46	0.33	0.38	0.38	0.50	0.58	0.58	0.52	0.60	0.60

Table 12: Percent mid parent heterosis (MH), better parent heterosis (BH) and standard heterosis (SH) for Oil content % and Protein content % in groundnut

S. No.	Crosses	Oil content %						Protein content %					
		Sick			Control			Sick			Control		
		MH	BH	SH	MH	BH	SH	MH	BH	SH	MH	BH	SH
1	K-6 x TCGS-1862	0.31	0.10	0.52	0.05	-0.41	0.52	0.48	0.38	0.38	3.47	1.75	5.24 *
2	K-6 x TCGS-2149	-1.56**	-1.77**	-1.36*	-1.25	-1.76*	-0.73	-1.71	-1.90	-1.90	-0.10	-3.91	4.03

3	K-6 x J-11	1.04	0.83	1.25*	0.26	-0.21	0.73	-6.12 **	-6.65 **	-6.65 **	-0.60	-1.20	0.00
4	K-6 x CS-19	-0.47	-0.62	-0.31	1.62 *	0.84	0.84	-2.48	-2.85	-2.85	8.73 **	7.03 **	10.48 **
5	Narayani x TCGS-1862	1.05	0.31	0.73	-0.62	-1.43	1.15	-0.47	-1.13	0.00	2.96	0.75	8.87 **
6	Narayani x TCGS-2149	0.31	-0.42	-0.00	-2.05 *	-2.80 **	-0.26	1.70	0.94	2.09	-2.33	-2.42	5.65 *
7	Narayani x J-11	0.63	-0.10	0.31	1.64 *	0.81	3.45 **	-5.32 **	-6.39 **	-5.32**	-2.12	-5.22 *	2.42
8	Narayani x CS-19	-0.68	-1.35 *	-1.04	0.21	-1.82 *	0.74	0.95	0.00	1.14	-1.34	-3.54	4.23
9	TAG-24 x TCGS-1862	-0.23	-0.47	0.42	-0.57	-0.62	0.31	-1.62	-1.71	-1.90	-2.32	-3.07	1.81
10	TAG-24 x TCGS-2149	0.18	-0.05	0.84	-0.21	-0.31	0.73	-0.76	-0.76	-1.14	-0.57	-2.05	6.05 *
11	TAG-24 x J-11	0.70	0.47	1.36*	-1.61 *	-1.66	-0.73	-5.75 **	-6.11 **	-6.46**	0.49	-1.34	3.63
12	TAG-24 x CS-19	0.44	0.16	1.04	1.72 *	0.52	1.36	0.00	-0.19	-0.57	-5.52 **	-6.33 **	-1.61
13	ICGV-07262 x TCGS-1862	-0.31	-0.62	0.42	0.10	-0.31	1.46	-0.39	-1.52	-1.71	1.50	-2.34	9.27 **
14	ICGV-07262 x TCGS-2149	-0.93	-1.24 *	-0.21	-0.67	-1.03	0.73	-0.87	-1.91	-2.28	-14.54 **	-15.93 **	-5.93 *
15	ICGV-07262 x J-11	-0.73	-1.03	-0.00	-0.31	-0.72	1.04	-0.87	-1.54	-2.66	-5.39 **	-9.91 **	0.81
16	ICGV-07262 x CS-19	-0.36	-0.72	0.31	0.09	-1.54	0.21	2.61	1.72	0.95	-8.90 **	-12.43 **	-2.02
17	ICGV-91114 x TCGS-1862	0.21	0.00	0.42	-1.29	-1.74 *	0.10	-0.86	-1.52	-1.71	-5.53 **	-5.98 **	-1.81
18	ICGV-91114 x TCGS-2149	-1.56 **	-1.77 **	-1.36*	-2.06 *	-2.46 **	-0.63	-1.34	-1.91	-2.28	-5.59 **	-7.26 **	0.40
19	ICGV-91114 x J-11	-0.21	-0.42	-0.00	-0.67	-1.13	0.73	0.96	0.77	-0.38	-3.33	-4.83 *	-0.60
20	ICGV-91114 x CS-19	-0.47	-0.62	-0.31	-3.92 **	-5.54 **	-3.76 **	-5.96 **	-6.32 **	-7.03**	-4.66 *	-5.21 *	-1.01
SE (Heterosis)		0.24	0.28	0.28	0.34	0.40	0.40	0.36	0.42	0.42	0.46	0.53	0-.53

Table 13: Percent mid parent heterosis (MH), better parent heterosis (BH) and standard heterosis (SH) for Percent Disease Incidence (PDI) at maturity in groundnut

S. No.	Crosses	Percent Disease Incidence (PDI) at maturity					
		Sick			Control		
		MH	BH	SH	MH	BH	SH
1	K-6 x TCGS-1862	-40.08 **	-64.90 **	-64.90**	-49.07	-74.50 **	-74.50 **
2	K-6 x TCGS-2149	-47.49 **	-70.75 **	-70.75**	50.72	-24.54	-24.54
3	K-6 x J-11	-50.13 **	-72.86 **	-72.86**	-1.85	-50.86	-50.93
4	K-6 x CS-19	-73.85 **	-85.14 **	-85.14**	-99.73 *	-99.86 **	-100.00 **
5	Narayani x TCGS-1862	14.13	-32.14 **	-38.51**	-1.92	-50.92 **	-26.39
6	Narayani x TCGS-2149	60.03 **	-9.89	-18.35*	-34.62	-67.28 **	-50.93
7	Narayani x J-11	-55.77 **	-75.72 **	-78.00**	-99.82 **	-99.91 **	-100.00 **
8	Narayani x CS-19	-36.43 **	-63.42 **	-66.86**	-99.82 **	-99.91 **	-100.00 **
9	TAG-24 x TCGS-1862	81.24 **	9.24	-8.86	-98.89	-99.44	-100.00**
10	TAG-24 x TCGS-2149	74.70 **	-0.69	-17.14*	495.00 *	199.16	-26.39
11	TAG-24 x J-11	-20.22	-55.87 **	-63.18**	296.67	99.44	-50.93
12	TAG-24 x CS-19	-44.51 **	-67.71 **	-73.06**	297.22	99.72	-50.93
13	ICGV-07262 x TCGS-1862	-56.00 **	-73.45 **	-78.00**	0.00	0.00	-100.00**
14	ICGV-07262 x TCGS-2149	-48.48 **	-70.69 **	-75.71**	0.00	0.00	-100.00**
15	ICGV-07262 x J-11	-66.39 **	-81.40 **	-84.59**	0.00	0.00	-26.39
16	ICGV-07262 x CS-19	48.01 **	-13.79	-28.57**	0.00	0.00	-100.00**
17	ICGV-91114 x TCGS-1862	33.14 **	-22.67 **	-17.96**	-100.00 *	-100.00 **	-100.00**

18	ICGV-91114 x TCGS-2149	-51.86 **	-73.34 **	-71.71**	-49.93	-74.93 **	-75.40 **
19	ICGV-91114 x J-11	34.23 **	-27.28 **	-22.85**	1.68	-49.09	-50.03
20	ICGV-91114 x CS-19	-56.14 **	-75.25 **	-73.74**	-100.00 *	-100.00 **	-100.00 **
SE (Heterosis)		4.57	5.28	5.28	1.56	1.80	1.80

Plate 1: Field view of evaluation of F_1 generation in sick plot condition during rabi, 2019.

Plate 2: Field view of evaluation of F_1 generation in control condition during rabi, 2019.

References

1. FAOSTAT, 2020-2021. Food and Agriculture Organization of the United Nations. World Agricultural Production, Rome, Italy. http://faostat.fao.org/.

2. Directorate of Economics and Statistics, Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Framers Welfare, GOI, 2021-22. *Agricultural statistics at a glance*. 50-51.

3. Arunachalam, V., Bandopadhyay, A., Nigam, S.N and Gibbons, R.W. 1984. Heterosis in relation to genetic divergence and specific combining ability in groundnut (*Arachis hypogaea* L.). *Euphytica*. 33(1): 33-39.

4. Ashok, J., Fakrudin, B., Paramesh, H., Kenchanagoudar, P.V and Kullaiswamy, B.Y. 2004. Identification of groundnut (*Arachis hypogaea* L.) germplasm resistant to stem and pod rot caused by *Sclerotium rolfsii* Saac. *Indian Journal of Genetics and Plant Breeding*. 64(3): 247:248.

5. Shull, G.H. 1908. The composition of a field of maize. Reports of the American Breeders Association. 4: 296-301.

6. Fonseca, S and Patterson, F.L. 1968. Hybrid vigour in a seven parents diallel cross in common winter wheat (*T. Aestivum* L.). *Crop Science*. 8: 85-88.

7. Snedecor, G.W and Cochran, W.G. 1967. *Statistical methods*. 6th Edition. *Iowa State University Press.* Ames, Iowa.

8. Paschal, E.H and Wilcox, J.R. 1975. Heterosis and combining ability in exotic soybean germplasm. *Crop Science.* 15: 344-349.

9. Vishnuvardhan, K.M. 2011. Genetic analysis of yield, yield attributes and resistance to late leaf spot and rust in a 8 × 8 diallel in groundnut (*Arachis hypogaea* L.). *Ph.D Thesis*. Acharya N.G. Ranga Agricultural University, Hyderabad.

10. John, K., Raghava Reddy, P., Hariprasad Reddy, K., Sudhakar, P and Eswar Reddy, N.P. 2012. Estimation of heterosis for certain morphological, yield and yield attributes in groundnut (*Arachis hypogaea* L.). *Legume Research*. 35(3): 194 -201.

11. John, K and Reddy, P.R. 2015b. Heterosis and inbreeding depression for yield and yield attributes in groundnut (*Arachis hypogaea* L.). *International Journal of Current Research in Biosciences and Plant Biology.* 2(7): 135-148.

12. Ravi, S. 2018. Genetic analysis for moisture stress tolerance, quality and yield traits in groundnut (*Arachis hypogaea* L.). *Ph.D. Thesis.* Acharya N.G. Agricultural University, Lam, Guntur, Andhra Pradesh.

13. Vishnuprabha, S.R., Viswanathan, P.L., Manonmani, S., Rajendran, L and Selvakumar, T. 2021. Estimation of heterosis and combining ability of yield traits in groundnut (*Arachis hypogaea* L.). *Indian Journal of Agricultural Research*. 5486: 1-7.

14. Jannat, S., Hassan, M., Nawaz Shah, K.M., Hussain Shah, A., Fariq, A., Mehmood, S., Qayyum, A., Gharib, F.A and El Askary, A. 2022. Genetic improvement of peanut (*Arachis hypogaea* L) genotypes by developing short duration hybrids. *Saudi Journal of Biological Sciences.* 302(15): 1-7.

15. Hubick K T, Farquhar G D and Shorter R 1986 Correlation between water use efficiency and carbon isotope discrimination in diverse peanut (*Arachis hypogaea* L.) germplasm. *Australian Journal of Plant Physiology*. 13:803-816.

16. Wright G C, Hubick, K. T and Farquhar, G.D 1988. Discrimination in carbon isotopes of leaves correlates with water use efficiency of field grown peanut cultivars. *Australian Journal of Plant Physiology*.15: 815-825.

17. Gonya Nayak, P., Venkataiah, M and Revathi, P. 2020. Combining ability and heterosis studies for yield and yield attributing characters in groundnut (*Arachis hypogaea* L.). *Current Journal of Applied Science and Technology*. 39(48): 566-572.

18. Rajesh, A.P. 2011. Genetic analysis of yield, physiological and confectionery traits in groundnut (*Arachis hypogaea* L.). Ph.D. Thesis. Andhra Pradesh Agricultural University, Hyderabad, India.

