SUMMARY AND CONCLUSION
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The present experiment entitled “Physiological studies on growth, development and productivity in summer groundnut (Arachis hypogaea L.) genotypes” was conducted during summer season of 2007 and 2008 with the objective to find out the suitable genotypes of groundnut for higher productivity and profitability.

The soil of the experimental field was sandy loam, having pH 8.0, organic carbon 0.33%, total nitrogen 0.03%, available phosphorus 10.00 kg/ha and available potassium 269.00 kg/ha initially before starting of present experiment. Groundnut (Arachis hypogaea L.) generally grown in rainy season, is severely affected by problem of water logging and diseases and pest incidence.

The availability of better genotypes of 85 to 90 days duration with suitable growth characters, physiological parameters and yield traits have made, they are not only feasible to include in multiple cropping with irrigations but also grow in summer season. The experiment was conducted in Randomized Block Design with three replications. Twenty bunch type genotypes of groundnut were tested during summer season. The treatments comprised of Dh 86 (T₁), Dh 40 (T₂), R 9251 (T₃), R 8808 (T₄), R 2000-1 (T₅), ICGS 44 (T₆), ICGS 1 (T₇), ICGS 37 (T₈), ICGS 11 (T₉), ICGS 76 (T₁₀), ICGV 93468 (T₁₁), ICGV 86590 (T₁₂), ICGV 86325 (T₁₃), ICGV 00310 (T₁₄), ICGV 00298 (T₁₅), ICGV 99195 (T₁₆), ICGV 02099 (T₁₇), ICGV 02022 (T₁₈),
ICGV 94361 (T_{19}), and G 201 (T_{20}- check). Recommended dose of 20 kg N + 30 kg P_{2}O_{5} + 45 kg K_{2}O/ha was applied to the experimental crop before seeding in furrows. Gypsum @ 100 kg/ha was given to summer groundnut at sowing and remaining 100 kg gypsum/ha applied between flower and pegs initiation stage before second interculture and mixed into soil. Four irrigations were given to different genotypes during summer season. The different genotypes were harvested on 12^{th} June during both the experimental seasons.

The observations were taken on growth characters, physiological parameters, yield attributes, yields, quality characters and economics of various genotypes. The important results obtained from these observations are summarized below. The results have been presented on the basis of pooled results of two years.

6.1 Growth characters:

1. The maximum plant height per plant was measured with genotype ICGV 99195 (30.16cm) closely followed by genotype ICGV 00298 (29.16 cm). The shorted plant height was recorded in Dh 86 (19.94 cm), which was at par with genotype ICGV 93468 (20.55 cm) in pooled results of two years.

2. Cultivar ICGV 99195 produced maximum branches per plant (16.82), which was at par with genotype ICGV 00298 (16.38). The minimum branches per plant were recorded in genotype Dh 86 (11.27), which was found at par with ICGV 93468 (11.49) in pooled results of two years.
3. The maximum number of functioning leaves per plant was found in ICGV 99195, which was statistically at par with genotype ICGV 00298 at 30 DAS, 60 DAS and 90 DAS of crop growth stages. The minimum number of functioning leaves per plant was noted in genotype Dh 86 and ICGV 93468 at 30, 60 & 90 DAS of crop growth stages in pooled results of two years.

4. At maturity stage maximum fresh weight of foliage per plant was recorded in genotype ICGV 99195 (84.27 g) followed by ICGV 00298 (83.82 g). Genotype Dh 86 gave lowest fresh weight of foliage per plant (76.05 g), while in genotype ICGV 93468, it was noted by 77.05 g per plant in pooled results of two years.

5. The improvement in dry weight of foliage was according to fresh weight of foliage, where noted significantly higher in genotype ICGV 99195. Cultivar ICGV 00298 produced statistically pat par dry weight of foliage per plant to the genotype ICGV 99195. Genotype Dh 86, which was statistically at par with genotype ICGV 93468 reduced the dry weight of foliage per plant over the other tasted genotypes.

6.2 Physiological parameters:

1. The leaf area per plant increased with plant age upto 90 DAS. On an average of both years of all genotypes, leaf area per plant from 30 to 60 DAS increased by 209%, while from 60 to 90 DAS it increased by 47%. The genotype ICGV 99195 registered
maximum leaf area per plant at all the stages of observations. The leaf area per plant increased by genotype ICGV 00298 was at par to the leaf area of genotype ICGV 99195. The lowest leaf area per plant was measured in genotype Dh 86 followed by ICGV 93468 at all the stages of observations in pooled results of two years.

2. The relative growth rate (RGR) per plant was higher between 30 and 60 DAS than between 60 and 90 DAS. On mean basis of all genotypes, RGR per plant between 30 and 60 DAS was recorded 62.31 mg/g/day, which was higher than the RGR per plant recorded at later stage of 60-90 DAS (14.32 mg/g/day). The significant difference was not recorded among different tested genotypes in relative growth rate per plant at both the stage of observations in pooled results of two years.

3. Net assimilation rate (NAR) per plant was higher between 30 and 60 DAS over between 60 and 90 DAS. On mean basis of pooled data of all genotypes, NAR between 30 and 60 DAS was noted 0.163 mg/cm²/day, which was higher than the NAR per plant recorded at later stage of 60 and 90 DAS (0.191 mg/cm²/day). The significant difference was not found among different tested genotypes in net assimilation rate per plant at both the stages of observations in pooled results of two years.

4. The leaf area ratio per plant was found higher between 30 and 60 DAS than later stage of 60 and 90 DAS. On average basis of
pooled data of all genotypes, LAR per plant between 30 and 60 DAS was recorded by 101.49 cm²/g/day, which was higher than the LAR per plant recorded between 60 and 90 DAS (74.71 cm²/g/day). The different tested genotypes did not show significant variation in leaf area ratio per plant at both the stages of observations in pooled results of two years.

5. The leaf area index per plant increased with plant age up to 90 DAS in all genotypes. The increase in LAI per plant from 30 to 60 days stage was found higher (211.66%) over 60 to 90 days stage (47.32%). The significant variation was not found among the tested genotypes in leaf area index per plant except in pooled data at 60 DAS, where significant variation was noted.

6. Leaf area duration was recorded higher between 60 and 90 DAS than between 30 and 60 DAS under all test genotypes. Genotype ICGV 99195 registered significantly maximum leaf area duration at both the stage of observations. Leaf area duration recorded in genotypes ICGV 00298 and ICGS 11 was found statistically at par with genotype ICGV 99195 at both the stages of observations. Genotype Dh 86 exhibited significantly minimum LAD, and it was closely followed by genotype ICGV 93468 at both the stages of crop growth in pooled results of two years.
6.3 Dry matter accumulation and distribution in different plant parts:

1. Variety ICGV 99195 produced the maximum dry weight of stem per plant (10.00 g) closely followed by variety ICGV 00298 (9.95 g). Cultivar Dh 86 produced minimum dry weight of stem per plant (8.93 g), which was statistically at par with cultivar ICGV 93468 (9.12 g) in pooled results of two years.

2. The cultivar ICGV 99195 (13.82 g) and ICGV 00298 (13.76 g) produced maximum dry weight of leaves per plant, which were superior to the other tested genotypes. Varieties Dh 86 (12.34 g) and ICGV 93468 (12.59 g) both produced minimum dry weight of leaves per plant in comparison to other genotypes in pooled results of two years.

3. Cultivar Dh 86 (26.53 g) and ICGV 93468 (26.34 g) yielded maximum dry weight of pods per plant, which was significantly higher than the dry weight of pods per plant produced by all other varieties except ICGV 00298 (25.53 g) and ICGV 99195 (25.66 g) because these genotypes produced statistically at par dry weight of prods per plant. Cv. Dh 40 (14.98 g) and G 201 (15.11 g) yielded lowest dry weight of pods per plant in comparison to all other genotypes in pooled results of two years.

4. The genotype ICGV 99195 (49.49 g) and ICGV 00298 (49.25 g) produced significantly higher total dry weight per plant over other genotypes, while variety Dh 40 (37.69 g) and G 201 (38.17 g)
produced minimum total dry weight per plant in pooled results of two years.

5. Genotypes Dh 86 (18.70 %) and ICGV 93468 (18.98 %) accumulated minimum percent dry matter in stem and maximum in pods by 55.50% & 54.82%, respectively.

The maximum dry matter of 25.35% & 25.30% in stem and minimum dry matter of 39.60% & 39.80% in pods were accumulated by genotypes G 201 and Dh 40, respectively.

Dh 86 (25.80 %) and ICGV 93468 (26.20 %) accumulated minimum percent dry matter in leaves, while genotypes G 201 (35.05 %) and Dh 40 (34.90 %) accumulated maximum percent dry matter in leaves.

6.4 Yield contributing characters:

1. There had been considerable increased in number of pods per plant in Dh 86 and ICGV 93468 over all other genotypes, which were statistically more effective in producing higher number of pods per plant but ICGV 00298 and ICGV 99195 produced statistically at par pods per plant in pooled results of two years.

2. The weight of pods per plant was enhanced considerably in genotypes Dh 86 and ICGV 93468 over all other genotypes. There was 75.57% and 74.32% increase in weight of pods per plant with Dh 86 and ICGV 93468 over local check of genotype G 201, respectively. Genotypes ICGV 00298 and ICGV 99195 showed
statistically at par pods weight per plant with genotypes Dh 86 and ICGV 93468 in pooled results of two years.

3. The number of kernels per plant was found significantly higher in genotypes Dh 86 and ICGV 93468 as compared to all other tested genotypes except genotype ICGV 99195, which was statistically at par to the both genotypes. The lowest number of kernels per plant was counted in genotypes Dh 40 and G 201 in pooled results of two years.

4. The weight of kernels per plant increased significantly in genotypes Dh 86 and ICGV 93468 over all other genotypes. The lowest weight of kernels per plant was weighed in genotype Dh 40 closely followed by genotype G 201 (check) in pooled results of two years.

5. The number of kernels per pod was found significantly higher in genotypes Dh 86 and ICGV 93468 as compared to other tested genotypes except ICGV 00298 and ICGV 99195, because these genotypes produced statistically at par kernels per pod to Dh 86 and ICGV 93468.

6. Genotypes ICGV 93468 and Dh 86 maintained the significantly higher kernels weight per pod over all other genotypes except ICGV 00298 and ICGV 99195, they produced statistically at par kernels weight per pod to the kernels weight per pod of ICGV 93468 and Dh 86. The lowest kernels weight per pod was noted in Dh 40 and G 201 in pooled results of two years.
7. There had been considerable improvement in weight of 100-kernel with Dh 86 and ICGV 93468 over all other genotypes. The cultivars Dh 40 and G 201 (check) were significantly reduced the 100-kernel weight in comparison to Dh 86 and ICGV 93468 in pooled results of two years.

6.5 Yield:

1. Cultivars Dh 86 (29.02 q/ha) and ICGV 93468 (28.91 q/ha) gave highest pods yield, which was significantly superior than all other tested genotypes except genotypes ICGV 99195 (28.02 q/ha) and ICGV 00298 (27.96 q/ha). The genotypes ICGV 99195 and ICGV 00298 produced statistically at par pods yield to Dh 86 and ICGV 93468. The genotypes Dh 40 (16.35 q/ha) and G 201 (check – 16.32 q/ha) gave minimum pods yield as compared to other genotypes in pooled results of two years.

2. The significantly highest straw yield was noted in genotype ICGV 99195 as compared to other genotypes. The minimum straw yield was weighed in Dh 86 and ICGV 93468 in pooled results of two years.

3. The biological yield was found maximum in genotypes ICGV 99195 and ICGV 00298. The lowest biological yield was recorded in genotypes ICGS 76 and R 8808 in pooled results of two years.

4. Cultivars Dh 86 (20.21 q/ha) and ICGV 93468 (20.10 q/ha) produced the highest kernels yield, while lowest was found in varieties G 201 (check – 11.15 q/ha) and Dh 40 (11.21 q/ha) in pooled results of two years.
6.6 Harvest index (%):

Cultivars Dh 86 and ICGV 93468 gave significantly higher harvest index than the all other tested genotypes. The lowest harvest index was recorded in genotypes G 201 (check), ICGS 11 and Dh 40 in pooled results of two years.

6.7 Shelling percentage:

There was no statistical difference recorded among the different genotypes for shelling percent, however, genotypes ICGV 93468 and Dh 86 displayed the higher shelling percent in pooled results of two years.

6.8 Quality parameters:

1. Oil percent in kernels improved considerably in genotypes ICGV 93468, ICGS 1, ICGS 11, ICGV 00310, ICGV 00298 and ICGV 99195 followed by genotypes Dh 86, ICGS 76, ICGV 02099, ICGV 02022, ICGV 86325 and ICGV 94361. The other tested genotypes declined oil percent as compared to above mentioned genotypes in pooled results of two years.

2. The significantly highest cake percent was recorded in cultivars R 2000-1 and R 8808 over the other tested genotypes in pooled results of two years.

3. The significantly highest oil yield was recorded in genotypes Dh 86 and ICGV 93468 than the other tested genotypes except
genotypes ICGV 99195 and ICGV 00298. Genotypes ICGV 99195 and ICGV 00298 produced statistically at par oil yield to the genotypes Dh 86 and ICGV 93468 in pooled results of two years.

4. The maximum cake yield was recorded in cultivars Dh 86 and ICGV 93468, which was significantly higher over the other tested genotypes but found statistically at par with cultivars ICGV 99195 and ICGV 00298 in pooled results of two years.

6.9 Economics:

1. The net return was found maximum by Rs 65262/ha and Rs 64877/ha with genotypes Dh 86 and ICGV 93468, respectively. The minimum net return was calculated by Rs 20812/ha with genotype G 201 (check) and Rs 20917/ha with genotype Dh 40.

2. Genotypes Dh 86 and ICGV 93468 brought out the maximum benefit cost ratio of 1:2.79 and 1:2.78, respectively, while lowest benefit cost ratio of 1:1.57 was recorded under genotypes G 201 and Dh 40.

6.10 Conclusions:

On the basis of the two years field investigation made during summer season of 2007 and 2008 in the riverine soil of Uttar Pradesh at ZARS, Mainpuri, the following conclusion are made:

1. The genotypes did not differ markedly to their relative growth rate (RGR) between 30-60 days and 60-90 days. On pooled mean
basis, the RGR was higher between 30-60 DAS (62.31 mg/g/day) and lower between 60-90 DAS (14.32 mg/g/day).

2. The genotypes did not differ much in net assimilation rate (NAR) between 30-60 DAS and 60-90 DAS, but on pooled mean basis it was higher between 30-60 DAS (0.613 mg/cm²/day) and lower between 60-90 DAS (0.190 mg/cm²/day).

3. The varieties did not differ significantly in leaf area ratio (LAR) between 30-60 DAS and 60-90 DAS, but on pooled mean basis it was higher between 30-60 DAS (101.49 cm²/g/day) and lower between 60-90 DAS (74.71 cm²/g/day).

4. During summer season, the leaf area index (LAI) increased with increase crop age but significant variation was not recorded among the different genotypes.

5. The different cultivars showed wide variability in leaf area (LA) per plant and leaf area duration (LAD). Genotypes ICGV 99195 and ICGV 00298 registered maximum leaf area per plant and leaf area duration. Lowest leaf area per plant and leaf area duration was measured in genotypes Dh 86 and ICGV 93468.

6. The minimum dry matter accumulation in stem and leaves and maximum dry matter accumulation in pods of Dh 86 and ICGV 93468 indicated the efficient source-sink relationship.

7. Genotypes Dh 86 and ICGV 93468 possessed high harvest index (major physiological parameter) due to efficient translocation of photosynthates during summer season.
8. Genotypes Dh 86 and ICGV 93468 maximized the pod yield in summer season.

9. The maximum yield of Dh 86 and ICGV 93468 was obtained by 29.02 q/ha and 28.91 q/ha, respectively, during summer season.

10. The genotypes Dh 86 and ICGV 93468 established the superiority in number of pods per plant; weight of pods per plant; number of kernels per plant; weight of kernels per plant; number of kernels per pod; kernels weight per pod; weight of 100-kernel, enhanced the kernels yield q/ha and pushed up oil yield q/ha.

11. In economics of different genotypes, the genotypes Dh 86 and ICGV 93468 gave highest net return of Rs 65262/ha and Rs 64877/ha, respectively. Dh 86 and ICGV 93468 also brought out the maximum benefit cost ratio of 1:2.79 and 1:2.78, respectively, in summer season.

12. Traits viz., dry matter accumulation, higher number of pods per plant, higher weight of pods per plant, higher number of kernels per plant, higher weight of kernels per plant, higher number of kernels per pod, higher kernels weight per pod, higher oil percent in kernels and better harvest index may be utilized by the breeder for varietal improvement of summer season groundnut.