International Journal of Agricultural Sciences
Volume **11** | Issue 2 | June, 2015 | 257-263 ■ e ISSN-0976-5670
☞DOI:10.15740/HAS/IJAS/11.2/257-263
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***RESEARCH PAPER***

# Effect of dates of sowing, varieties and growth regulator on growth and yield attributes on summer groundnut (*Arachis hypogaea* L.) under north Gujarat agro-climatic conditions

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**Abstract :** A field experiment was conducted during summer-2010 at Agronomy Instructional Farm, C.P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, to study the effect of dates of sowing, varieties and growth regulator on growth and yield attributes on summer groundnut (*Arachis hypogeia* L.) under north Gujarat agro-climatic conditions. The soil of the experimental field was loamy sand in texture, low in nitrogen, medium in available phosphorus and rich in available potash. The experiment was laid out in Factorial Randomized Block Design with three replications. Eighteen treatment combinations comprised of three levels of dates of sowing *viz.*, $D_1$ - 1st February, $D_2$ – 14th February and $D_3$ – 28th February; three levels of varieties *viz.*, $V_1$ – GG-2, $V_2$ – GG-5 and $V_3$ - GG-7 and two levels of growth regulator *viz.*, $G_0$ – control and $G_1$ – 50 ppm IBA spray 20 and 40 DAS. The performance of all growth and yield attributes recorded highest plant height(27.35 cm), pods yield (3065 kg/ha)and test weight (50.42 g) was observed in 28 February snowcrop.

**Key Words :** Dates of sowing, Varieties, Growth regulator, Growth, Yield attributes

**View Point Article :** Jangilwad, B.D., Pagar, R.D., Warkad, K.V. and Patel, S.K. (2015). Effect of dates of sowing, varieties and growth regulator on growth and yield attributes on summer groundnut (*Arachis hypogaea* L.) under north Gujarat agro-climatic conditions. *Internat. J. agric. Sci.*, **11** (2) : 257-263.

**Article History : Received :** 28.03.2015**; Revised :** 13.05.2015**; Accepted :** 22.05.2015

## INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is edible oil seed crop of Leguminaceae family in the world. The name *Arachis hypogaea* L. is derived from the Greek word *Arachis* means the legume and *hypogaea* means below ground. It originated in South America, from where it spread to Asia, Africa, Sudan, Nigeria, USA and other parts of the world. It is self-pollinated, allotetraploid legume with the chromosome number (2n=40). Groundnut has three distinct botanical groups *viz.*, Spanish, Valencia and Virginia. In Gujarat, the average productivity was 929 kg $ha^{-1}$ in *Kharif* and 1903 kg $ha^{-1}$ in summer season (DOE, 2010), in India, in the *Kharif* season, it is grown on 69.52 million ha with production of 56.17 million tonnes with an average productivity of 808 kg $ha^{-1}$, whereas, in summer season, it is grown on 7.91 million ha with production of 15.51 million tonnes with an average productivity of 1960 kg $ha^{-1}$ (DOE,

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2010). Groundnut has rich source of the energy as it contains 40-50 per cent edible oil, remaining 50 per cent seed has high quality protein of 21.4-36.6 per cent (Sekhon *et al.,* 1970), carbohydrates (9.5-24%) and having minerals like calcium, magnesium, iron and vitamins like $B_1$ and $B_2$ (Das, 1997). Application of growth regulators is also known to increase flowering, fruit setting, grains filling and test weight in different crops (Crosby *et al.*, 1981). Thus, use of plant growth regulators is one of the best possible way to alleviate the stagnation in groundnut production. The normal metabolism and growth processes responsible for yield formation are infact, controlled by growth regulators.

Perusal of the literature indicates that very little research work has been done under North Gujarat conditions, hence, the present investigation was conducted during summer 2010.

## MATERIAL AND METHODS

The field experiment was conducted during summer season of the year 2010 on plot number A-4 at the Agronomy Instructional Farm, C.P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar (Gujarat). The climate of this region is sub-tropical monsoon type and falls under semi-arid region, monsoon commences in the middle of June and retreats by the middle of September; most of the precipitation is received from the South-West monsoon, concentrating in the month of July and August. The annual average rainfall was about 550 mm in 21 rainy days (1998-2009). The soil of the experimental plot was measured by two depth 0-15 cm and at 15-30 cm, it was observed that soil is loamy sand in texture, low in organic carbon (0.17 %) at 15-30 cm depth and available nitrogen (138 kg/ha), medium in available phosphorus (49 kg/ha) and high in available potash (279 kg/ha). Electrical conductivity was very low showing that the soil was free from salinity hazard. The experiment was laid out in a Randomized Block Design with Factorial concept (FRBD), there were 54 plots for the three sowing dates $D_1$: 1st February, $D_2$: 15th February, $D_3$: 28th February, three varieties $V_1$: GG -2, $V_2$: GG -5, $V_3$: GG -7 and growth regulator $G_0$: control, $G_1$: 50 ppm (IBA spray at 20 and 40 DAS) with three replications. Sowing was done on $D_1$: 1st February 2010, $D_2$: 15th February 2010, $D_3$: 28th February 2010 by hand sowing with 30×10 cm with weighed quantity of seed and harvested on $D_1$: 15th May 2010, $D_2$: 24th May 2010, $D_3$: 28th May 2010. Biometric observations were recorded by selected five plants from each plot randomly and marked with proper rotations. These plants were harvested at maturity separately for assessing individual plant yield. The growth parameters and yield parameters were studied. Chemical analysis was done by the scientific methods. Nitrogen was analysed by (*kjehdahls* method), phosphorus (Spectrophotometer) and potassium by Flame photometer.

## RESULTS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under following heads :

**Growth characters plant height :**

*Effect of sowing dates* :

An appraisal of the data presented in Table 1 revealed that at harvest were found to be non-significant due to dates of sowing. The plant height was significant due to dates of sowing at 90 DAS. Significantly higher plant height was recorded under $D_3$ (27.35 cm), but it was statistically at par with $D_1$ (27.10 cm). The magnitude of the increase in plant height due to $D_3$ was 0.93 and 2.47 per cent over the $D_1$ and $D_2$ dates of sowing, respectively. Taller and larger plants height under $D_3$ may be due to favourable climatic condition (temperature, relative humidity and bright sunshine hours etc.) for growth, especially optimum temperature in early growth stages available to the crop. Whereas, in case of $D_1$ the low temperature during the early stages resulted in significantly lower plant height.

These finding are in accordance with those reported by Joshi and Patel (1985) They reported that significantly lower plant height, was recorded under earlier crop sown on 1st February over the rest of sowing dates.

*Effect of varieties* :

Plant height at 90 DAS (27.61 cm) and at harvest (41.05 cm) was significantly higher under GG-5 ($V_2$) variety, respectively, but it was statistically at par with GG-7 ($V_3$) variety with 27.50 cm and 41.00 cm, respectively, at both growth period. The magnitude of the increase in plant height due to $V_2$ was 0.4 and 6 per cent over the $V_3$ and $V_1$ varieties, respectively, whereas 6.4 per cent over the plant height of $V_1$ at the harvest.

These finding are in accordance with those reported by Rafey and Prasad (2003). They reported the highest plant height at the time of harvest was under Ak-12-24 51.2 cm followed by BG-3, k-134 and G.G.-2.

*Effect of growth regulator* :

The data of plant height in Table 1, revealed that the effect of IBA application was non-significant in case plant height of groundnut at 90 and at harvest.

*Interaction effect* :

At 90 DAS plant height was significantly influenced by the interaction of dates of sowing × varieties and varieties × growth regulator (Table 1a and 1b).

The higher value of plant height at 90 DAS under 3rd date of sowing (28 February) may be attributed to higher temperature which might have induced the vegetative growth of plant through photosynthesis. The reason for maximum number of mature pods per plant in

**Table 1 : Mean of plant height (cm) and primary branches plant$^{-1}$ as influenced by sowing dates, varieties and growth regulator in groundnut**

| Treatments | Plant height (cm) | | Primary branches |
|---|---|---|---|
| | 90 DAS | At harvest | |
| **Date of sowing** | | | |
| $D_1$ : 1st February | 27.10 | 39.95 | 3.93 |
| $D_2$ : 14th February | 26.69 | 40.18 | 3.98 |
| $D_3$ : 28th February | 27.35 | 40.48 | 4.01 |
| S.E. ± | 0.14 | 0.75 | 0.083 |
| C.D. (P=0.05) | 0.42 | NS | NS |
| **Varieties** | | | |
| $V_1$ : G.G.-2 | 26.03 | 38.57 | 3.93 |
| $V_2$ : G.G.-5 | 27.61 | 41.05 | 3.98 |
| $V_3$ : G.G.-7 | 27.50 | 41.00 | 4.01 |
| S.E. ± | 0.14 | 0.75 | 0.083 |
| C.D. (P=0.05) | 0.42 | 0.62 | NS |
| **Growth regulator** | | | |
| $G_0$ : Control | 26.03 | 40.14 | 3.97 |
| $G_1$ : IBA spray | 27.61 | 40.28 | 3.98 |
| S.E. ± | 27.50 | 0.61 | 0.068 |
| C.D. (P=0.05) | 0.14 | NS | NS |
| **Interaction** | | | |
| D × V | 0.25 | NS | NS |
| D × G | NS | NS | NS |
| V × G | 0.21 | NS | NS |
| D × V × G | NS | NS | NS |
| C.V.% | 2.26 | 2.28 | 8.90 |

NS=Non-significant

**Table 1a : Plant height at 90 DAS as influenced by interaction of dates of sowing and varieties (D × V) in groundnut**

| Varieties | Date of sowing | | |
|---|---|---|---|
| | $D_1$ | $D_2$ | $D_3$ |
| $V_1$ | 25.80 | 26.03 | 25.93 |
| $V_2$ | 28.20 | 26.61 | 28.03 |
| $V_3$ | 27.30 | 27.43 | 27.76 |
| C.D. (P=0.05) | | 0.258 | |

**Table 1b : Plant height at 90 DAS as influenced by interaction of varieties and growth regulator (V × G) in groundnut**

| Growth regulator | Varieties | | |
|---|---|---|---|
| | $V_1$ | $V_2$ | $V_3$ |
| $G_1$ | 24.91 | 28.35 | 28.26 |
| $G_2$ | 26.93 | 26.87 | 26.73 |
| C.D. (P=0.05) | | 0.21 | |

GG-5 may be attributed to its inherent ability. These finding are in accordance with those reported by Mane *et al*. (2010), they recorded the maximum plant height at 7th June than the rest of sowing dates and among the varieties Konkan Tapora over rest variety.

*Primary branches per plant* :

The data regarding effects of date of sowing, varieties and growth regulator on primary branches per plant are presented in Table 1.

Data revealed that different treatments of dates of sowing, varieties and growth regulator tried in this experiment did not exert their significant effect on primary branches per plant of groundnut.

**Yield and yield attributes :**

***Effect of sowing dates :***

Effect of dates of sowing was non-significant on total number of pods per plant, total pods weight per plant and haulm yield (Table 2). The significantly highest pods yield of groundnut (3065 kg/ha) was recorded under the $D_3$ (28 February). The magnitude of increase in pods yield under $D_3$ was to the tune of 8.30 and 33.20 per cent over $D_2$ (14th February) and $D_1$ (1st February), respectively. The effect of sowing dates on harvest index was significant. Significantly higher harvest index (47.4) was found in 28th February ($D_3$) which was statistically at par with 14th February ($D_2$). The magnitude of increase in harvest index under $D_3$ was to the tune of

**Table 2 : Mean of total number of pods/ plant, total pods weight/plant (g), pods yield (kg/ha), haulm yield (kg/ha), harvest index (%) and test weight as influenced by sowing dates, varieties and growth regulator in groundnut**

| Treatments | Total number of pods/plant | Total pods weight/ plant (g) | Pods yield (kg/ha.) | Haulm yield (kg/ha.) | Harvest index (%) | Test weight (g) |
|---|---|---|---|---|---|---|
| **Date of sowing** | | | | | | |
| $D_1$ : 1st February | 26.45 | 43.95 | 2301 | 3117 | 42.4 | 46.60 |
| $D_2$ : 14thFebruary | 29.01 | 46.79 | 2830 | 3367 | 43.8 | 48.73 |
| $D_3$ : 28th February | 29.56 | 48.42 | 3065 | 3563 | 47.4 | 50.42 |
| S.E. ± | 0.948 | 2.049 | 114 | 134 | 1.3 | 0.80 |
| C.D. (P=0.05) | NS | NS | 328 | NS | 3.8 | 2.29 |
| **Varieties** | | | | | | |
| $V_1$ : G.G.-2 | 25.51 | 35.74 | 2478 | 2938 | 45.1 | 40.62 |
| $V_2$ : G.G.-5 | 32.27 | 60.47 | 3087 | 3699 | 45.4 | 53.41 |
| $V_3$ : G.G.-7 | 27.24 | 42.91 | 2631 | 3410 | 43.1 | 51.72 |
| S.E. ± | 0.94 | 2.04 | 114 | 134 | 1.3 | 0.80 |
| C.D. (P=0.05) | 2.68 | 5.89 | 328 | 388 | NS | 2.29 |
| **Growth regulator** | | | | | | |
| $G_0$ : Control | 27.36 | 45.09 | 2710 | 3291 | 44.9 | 47.25 |
| $G_1$ : IBA spray | 29.32 | 47.69 | 2754 | 3407 | 44.2 | 49.92 |
| S.E. ± | 0.778 | 1.67 | 93 | 110 | 1.1 | 0.65 |
| C.D. (P=0.05) | NS | NS | NS | NS | NS | 1.87 |
| **Interaction** | | | | | | |
| D × V | NS | 10.20 | NS | NS | NS | NS |
| D × G | NS | NS | NS | NS | NS | NS |
| V × G | NS | NS | NS | NS | NS | NS |
| D × V × G | NS | NS | NS | NS | NS | NS |
| C.V.% | 13.96 | 19.35 | 17 | 17 | 13 | 6.98 |

NS=Non-significant

**Table 3 : Pods weight per plant as influenced by interaction of dates of sowing and varieties (D × V) in groundnut**

| Varieties | Date of sowing | | |
|---|---|---|---|
| | $D_1$ | $D_2$ | $D_3$ |
| $V_1$ | 32.88 | 35.12 | 48.22 |
| $V_2$ | 57.12 | 61.45 | 62.80 |
| $V_3$ | 33.10 | 35.04 | 68.58 |
| C.D. (P=0.05) | | 10.20 | |

8.21 and 11.79 per cent over $D_2$ (14th February) and $D_1$ (1st February), respectively.

This may be due to favourable climatic condition (*i.e.*, temperature, relative humidity and bright sunshine hours etc.) with less weed competition and incidence of pest and disease and $D_1$ (early sowing) produced significantly lower pods yield. Patel and Singh (1988) also observed significantly higher pods yield and haulm yield under 20th February sowing over the rest of sowing dates. The data showed significant effect on test weight in $D_3$ date of sowing (50.42) which was at par with $D_2$date of sowing (48.73). The magnitude of increase in test weight under $D_3$ (28 February) was to the tune of 3.26 and 8.19 per cent over $D_2$ (14th February) and $D_1$ (1st February) dates of sowing, respectively. This may be due to the favourable climatic condition during the pods development stages. Favourable climatic condition (*i.e.*, temperature, relative humidity and bright sunshine hours) so, this treatment has received sufficient period for growth and pods development, flowering and fruiting which ultimately resulted into more vigorous effect on test weight. Another probable reason for higher test weight may be attributed to translocation of photosynthates toward sink.

The results are in confirmation with those reported by Patel and Patel (1996). They observed significantly higher test weight and oil content under 20th February sowing over the rest of sowing dates. The results are in line with Patel and Patel (1992); Patel *et al.* (1996); Patel and Patel (1996); Patel *et al.* (1998); Reddy *et al.* (2000); Rinjumoni (2000); Kalita *et al.* (2003); Rafey and Prasad (2003); Datke *et al*. (2003); Thakare *et al*. (2006); Dhadge *et al.* (2008); Chandrika *et al.* (2008); Sardana and Kandhola (2009); Ravisankar *et al.* (2010); Mane *et al.* (2010) and Parmar *et al.* (2011).

*Effect of varieties* :

The data given in Table 2 indicated that significantly higher numbers of pods per plant were recorded under GG-5 variety (32.27). Number of pods per plant in GG-5 variety over GG- 7 (27.24) and GG-2 (25.51) varieties was to the tune of 5 and 26 per cent, respectively. The reason for maximum total number of pods per plant in GG-5 may be attributed to its inherent ability with better genotype character. The present finding are in agreement with those reported by Kalaria and Sinha (1984).

Total pods weight per plant was significantly highest in GG-5 because of higher more number of mature pods per plant and total number of pods per plant (Table 2). The magnitude of increase in pods per plant under GG-5 ($V_2$) variety was to the tune of 40 and 60 per cent over GG-7 ($V_3$) and GG-2 ($V_1$) varieties, respectively. Similar results were reported by Parmar *et al.* (2011); Mane *et al*. (2010); Ravisankar *et al*. (2010); Sardanab and Kandhola (2009); Chandrika *et al.* (2008); Dhahge *et al*. (2008); Sesay *et al*. (2008); Vishwakarma *et al*. (2008); Thakare *et al.* (2006); Datke *et al.* (2003); Kalita *et al.* (2003); Rafey and Prasad (2003); Reddy *et al.* (2000); Rinjumoni (2000) and Suresha (2000) also reported similar type of results.

Significantly highest pods yield of groundnut (3087 kg/ha) was recorded under GG-5 which was statistically superior over GG-2 and GG-7. The magnitude of increase in pods yield under GG-5 ($V_2$) variety was to the tune of 17.32 and 24.59 per cent over GG-7 ($V_3$) and GG-2 ($V_1$) varieties, respectively. The higher yield under variety GG-5 is due to more number of primary branches total pods weight per plant and test weight (Table 2) which gave maximum pods yield over rest of the varieties, another probable reason for higher pods yield by GG-5 may be it might have utilized more nutrients.

These finding are accordance with those reported by Gohil and Damane (1999). The significantly highest haulm yield of groundnut (3699 kg/ha) was recorded under the GG-5. The data also indicated significantly higher test weight under GG-5 (53.41) which was at par with GG-7 (51.72). The magnitude of increase in test weight under $V_2$ (GG-5) variety was to the tune of 3.26 and 31 per cent over $V_3$ (GG-7) and $V_1$ (GG-2) varieties, respectively. Similar result were reported by Kalaria and Sinha (1984).

*Effect of growth regulator* :

The data also revealed significant effect of growth regulator on test weight of groundnut kernel. Maximum test was recorded with application of IBA ($G_1$) than the control ($G_0$) (Table 2).

Similar finding were reported by ThakareKetki *et al.* (2006). They found maximum test weight in ½ RDF + DAP (2%) + IAA (50 ppm) followed by ½ RDF + Urea (2%) + IAA (50 ppm).

*Interaction effect* :

Karanjikar *et al.* (2008) observed taller plants when the crop was sown on 15th and 30th September as compared to subsequent sowing dates. Among the

genotypes, Spanish bunch genotype SB-XI was significantly taller than the rest of genotype at harvest during both the seasons.

Total pods weight per plant was significantly influenced by interaction effect of dates of sowing and varieties (D × V). The data reported in Table 3 revealed that significantly higher pods weight per plant (68.58 g) was recorded with GG-7 ($V_3$) variety when it was sown on the third date of sowing ($D_3$), but it was statistically at par with treatment combination $D_2V_2$ (14th February with GG-5) and $D_3V_2$ (28th February with GG-5). Similar finding were reported by Barik *et al.* (1988).

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