# THE EFFECT OF NITROGEN FERTILIZER AND IRRIGATION MANAGEMENT ON PEANUT (ARACHIS HYPOGAEA L.) YIELD IN THE NORTH OF IRAN

# EFFETS D'ENGRAIS D'AZOTE ET DE LA GESTION D'IRRIGATION SUR LE RENDEMENT D'ARACHIDE (ARACHIS HYPOGAEA L.) AU NORD DE L'IRAN

Ali Abdzad Gohari[1] and Ebrahim Amiri[2]

## *ABSTRACT*

*In order to investigate the effect of irrigation and nitrogen fertilizer on peanut, a split-plot experiment was conducted in randomized complete block design with 4 irrigation levels and 4 Nitrogen levels in 3 replications in 2009 at Astaneh Ashrafiyeh in Guilan, Iran. Irrigation treatments ($I_1$, $I_2$, $I_3$ and $I_4$, correspondingly, dry farming and irrigation intervals of 6, 12, and 18 days) were imposed on the main plots and Nitrogen treatments ($N_0$, $N_1$, $N_2$ and $N_3$, correspondingly, 0, 30, 60 and 90 kg/ha) were imposed on the sub-plots. According to the analysis of results, irrigation and nitrogen fertilizer had significant effects on seed yield, total biomass, 100-seed Weight, the number of seeds on plant, width and length of seed. The results of this investigation showed that in irrigation treatments, the maximum seed yield of 2345 kg/ha was in $I_2$ and in N treatments, the highest yield of 1796 kg/ha was in $N_3$.*

***Key words:*** *Peanut, Irrigation, Nitrogen Fertilizer, Split-plot, Yield.*

## *RESUME*

*Afin d'étudier l'effet de l'irrigation et d'engrais azotés sur les arachides, une expérience a été créé en blocs complets randomisés a été arrangement split-plot avec trois répétitions en 2009 à Achrafieh Astaneh de Guilan, en Iran. L'irrigation a été que le facteur principal de la parcelle qui se composait de quatre niveaux de la culture sèche, 6, 12, et 18 jours d'intervalle (I1, I2, I3 et I4, respectivement). facteur de sous-parcelles a été d'engrais azotés dans les quatre*

1 Department of Agriculture, Islamic Azad University, Shoushtar Branch, Shoushtar, Iran.
aag_aligohari@yahoo.com
2 Department of agriculture, Lahijan Branch, Islamic Azad University, Lahijan, Iran. Corresponding author. E-mail address: eamiri@iau-lahijan.ac.ir and eamiri57@yahoo.com

*niveaux de 0, 30, 60 et 90 kg / ha (en abrégé, N0, N1, N2 et N3). Selon l'analyse des résultats, l'arrangement d'irrigation et d'engrais d'azote ont des effets significatifs sur le rendement grainier, la biomasse totale, poids de 100 graines, le nombre de graines sur la plante, la largeur et la longueur des semences. Les résultats de cette enquête a montré que dans les traitements d'irrigation, le rendement en graines maximum est dans I2 eu le rendement le plus élevé avec 2345 (kg/ha), entre les quantités d'azote, le N3 avec le rendement grainier de 1796 (kg / ha) a été le plus élevé.*

***Mots clés :*** *Arachide, irrigation, engrais d'azote, champ divisé, rendement.*

*(Traduction française telle que fournie par les auteurs)*

# 1. INTRODUCTION

Peanut is planted in arid and semi arid areas and is very rich in protein and oil quality. The origin of this plant is an area called Gran chaco in Brazil. Drought is one the limiting factor in the yield of peanut in most of the countries (Awal and Ikeda, 2002; Recbly et al, 2003). In recent years, due to drought and its yield has declined. El-Boraie et al (2009) concluded that Groundnut yield is reduced under water stress.

Under water stress, limited growth of root nodes inhibits N fixing bacterial action. Hence, application of N fertilizer becomes important. Drought stress reduces the stabilization in Leguminous plants (Hungria and vargas, 2000; Giler, 2001), especially in peanut (Sinclair et al 1995). According to the statistics, United States, China, India, Nigeria, Indonesia, Burma and Senegal have the highest area under peanut production. Peanut in Iran is planted in Golestan, Khouzestan and Guilan. According to statistics of the Guilan Agriculture Organization (2005) this province has 2555 h of peanut plantation, 8656.6 ton of production and the yield value is 3388kg/ha. It is mostly planted in Astaneh, Kiyashahr, Lashtenesha and Kisom. Due to the lack of studies on the effect of irrigation and N fertilization on the yield of peanut; the farmers have to be advised about these issues to prevent yield reduction. So the Purpose of the Present study is to find the effects of Irrigation and N fertilizer on yield a water use efficiency of peanut.

# 2. MATERIALS AND METHODS

This experiment was conducted in 2009 in the city of Astaneh in Guilan province (37°16' N latitude; 46°56' E longitude; 3 m above the sea level). The rainfall during the growth season is approximately 200 mm. The experiment was established in randomized complete block design as split-plot arrangement with three replications. Irrigation was as main-plot factor consisting of four levels: dry farming, 6, 12, and 18 day interval ($I_1$, $I_2$, $I_3$ and $I_4$ respectively). Sub-plot factor was nitrogen fertilizer in four levels 0, 30, 60 and 90 kg/ha ($N_0$, $N_1$, $N_2$ and $N_3$, respectively). Each plot size was 6 2.5 $m_2$.

Table1. Information on meteorological data

| Month | Maximum Temperature (°C) | Minimum Temperature (°C) | Sun Shine (h) | Rain fall (mm) | Wind Speed (m/s) | Evaporation of pan (mm) | Maximum Humidity (%) | Minimum Humidity (%) |
|---|---|---|---|---|---|---|---|---|
| May | 27.3 | 17.3 | 6.5 | 39.5 | 1.2 | 4.1 | 92 | 58.9 |
| Jun | 41.9 | 20 | 8.5 | 0 | 0.9 | 6.3 | 85.9 | 49 |
| Jul | 29.5 | 18.8 | 3.9 | 149.5 | 0.3 | 2.5 | 93.4 | 66.9 |
| Aug | 28.4 | 18.5 | 4.4 | 11 | 0.9 | 3.4 | 91.3 | 63.8 |

Table2. Characteristics of soil in the study area

| Particle size distribution % | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Soil depths (Cm) | Sand | Silt | Clay | Total nitrogen | Organic carbon | Soil Texture | Potassium absorbent (ppm) | Phosphor absorbent (ppm) | Electrical Conductivity (ds/m) |
| 0-20 | 49 | 32 | 32 | 0.084 | 0.68 | Loamy | 239 | 0.07 | 0.631 |
| 20-40 | 49 | 19 | 19 | 0.065 | 0.66 | Loamy | 191 | 2.17 | 0.565 |

To prepare the land, the field was plowed and the soil was pulvesised by using a disc before the plantation. The plant variety was selected from the local type of (Guil Badam). The seed was given anti-fungal treatment with Carboxin Tyram with two per thousand ratios (Craufurrd et al 2002). Maintenance and harvesting operation were done according to the physiological stages. Weeding was done three times to control the grass growth. After harvesting, the bushes were kept in the open air for one week (Bell et al 1987). At the end of the season, total biomass, thousand seed weight, and number of seeds in a Plant, length and width of the seeds were measured. In order to measure seed yield, after the omission of two rows of each side, the seeds were carefully weighed. The amount of water used during the growth period was provided through irrigation and rains.

# 3. RESULTS AND DISCUSSION

Variance analysis showed that irrigation and nitrogen was significant on all measured parameters (Table 3). The average seed yield showed that $I_2$ treatment in comparison with $I_1$, $I_3$, and $I_4$ gave, respectively 145%, 55% and 64 % of increase in yield. It had the highest bunch yield (Fig. 1b) and the highest seed yield (Fig. 1a). The effects of different N levels showed that $N_3$ in comparison to $N_1$, $N_2$ and $N_4$ treatment gave, respectively, 13, 6 and 10 per cent of higher pod yield in (Fig. 2a). Seed yield in $N_3$ in comparison to $N_1$, $N_2$, and $N_4$ have, respectively, increased yield by 27, 10 and 27 per cent (Fig. 2a). The results of this study show that maximum yield reduction in the peanut is related to drought stress. Water stress mostly affects seed yield and other growth of parameters (Rucker et al, 1995, Pimratch et al. 2008 , Songsri et al. 2009). Pallas et al (1979) also found that in the case of peanut if the drought occurs during 71 to 105 or 105 to 145 days, the pod function decreases and the filling period or the critical period essentially needs water. The results of mean comparisons

proved that the total biomass in $I_2$ had a significant difference with other treatments. Also among N treatments, $N_3$ was the best with the mean yield of 7330 kg/ha and the $N_1$ treatment with the mean yield of 5624 kg/ha was the poorest. This difference was significant (Table 5). Confirmation of the figure can be viewed in the work of researches such as of Songsri et al (2008) where in total watering condition and Water stress they studied the peanut found significant difference in the total biomass value. Haro et al (2008) studied two types of peanut under watering and stress for two years and found that the biomass value under stress was less than the irrigated situation.

Table 3. Mean squares form the combined ANOVA for pod yield, seed yield, biomass, 100 seed weight, width and length of seed.

| Source | df | Pod yield | Seed yield | Total Biomass | 100-seed weight | Number seed of plant | Width of seed | Length of seed |
|---|---|---|---|---|---|---|---|---|
| Repli-cation | 2 | 3103056.06 | 602989.22 | 16644305.29 | 474.295 | 3749.333 | 0.435 | 1.254 |
| Irri-gation | 3 | 5123149.80** | 4011458.68** | 49815914.42** | 2974.422** | 4214.083** | 0.167** | 1.062** |
| Error | 6 | 44237.19 | 29825.89 | 682523.92 | 17.36 | 22.667 | 0.004 | 0.007 |
| Nitro-gen | 3 | 379052.82** | 431727.28** | 1456807.84** | 471.467** | 144.972** | 0.035** | 0.057** |
| I×N | 9 | 1104128.09** | 551690.21** | 3478867.75** | 141.339** | 1425.194** | 0.004** | 0.007** |
| Error | 24 | 45668.36 | 14427.88 | 222905.42 | 1.306 | 6.556 | 0.001 | 0.001 |
| CV(%) | | 6.80 | 7.71 | 6.90 | 2.78 | 2.23 | 3.15 | 1.36 |

**,*: Significant at 1, 5% level and ns: Not significant

Table 4. Mean comparative on pod yield, seed yield, biomass, 100 seed weight, width and length of seed.

| Treatment | Total Biomass (kg/ha) | 100-seed Weight (g) | number seed of plant | width seed (Cm) | Length seed (Cm) |
|---|---|---|---|---|---|
| $I_1$ | 4612 d | 23 d | 96 d | 0.97 d | 1.94 d |
| $I_2$ | 9453 a | 60 a | 140.5 a | 1.25 a | 2.61 a |
| $I_3$ | 7200 b | 46 b | 115.2 b | 1.09 c | 2.20 b |
| $I_4$ | 6111 c | 34 c | 108.5 c | 1.17 b | 2.04 c |
| $N_1$ | 6524 b | 33 d | 111.2 d | 1.05 c | 2.10 b |
| $N_2$ | 6836 b | 38 c | 113.7 c | 1.10 b | 2.23 a |
| $N_3$ | 7330 a | 47 a | 119.3 a | 1.15 a | 2.23 a |
| $N_4$ | 6685 b | 44 b | 116 b | 1.17 b | 2.23 a |

The results of mean comparison prove that the $I_2$ treatment with the mean weight of 100 seeds of 60.3 (g) has the highest value among all other irrigation treatments and is due to the higher weight of 100 seeds (Table 4). The effects of different levels of N were sush that the maximum weight of 100 seeds was provided in $N_3$ treatments and had a significant difference with $N_1$, $N_2$ and $N_4$ treatments (Table 4). In comparison with different irrigation levels, $I_4$ treatment with 140 seeds had the highest seed number in each pod and had 46, 22 and 30 percent of increase in comparison with $I_1$, $I_3$ and $I_4$ treatment (Table 4). In the nitrogen fertilizer level, the maximum seed belonged to $N_3$ treatment with 119 seeds with a significant difference in comparison with other treatments (Table 4).

Table 5. Interaction of irrigation and nitrogen fertilizer on pod yield, seed yield, biomass, 100 seed weight, width and length of seed.

| Treatment | Total Biomass (kg/ha) | 100-seed Weight (g) | number seed of plant | width seed (cm) | Length seed(cm) |
|---|---|---|---|---|---|
| $I_1$ $N_1$ | 4918 gh | 18.10 l | 98 h | 0.90 f | 1.87 h |
| $I_1$ $N_2$ | 5107 gh | 19.91 l | 101 gh | 0.90 f | 2.00 g |
| $I_1$ $N_3$ | 3591 i | 23.40 k | 71 j | 1.03 e | 1.90 h |
| $I_1$ $N_4$ | 4828 h | 33.25 i | 114 f | 1.07 de | 2.00 g |
| $I_2$ $N_1$ | 8630 c | 43.82 e | 114 f | 1.20 b | 2.53 c |
| $I_2$ $N_2$ | 10144 a | 61.99 c | 148 b | 1.20 b | 2.63 b |
| $I_2$ $N_3$ | 9864 ab | 71.22 a | 162 a | 1.30 a | 2.70 a |
| $I_2$ $N_4$ | 9171 bc | 64.24 b | 138 c | 1.30 a | 2.60 b |
| $I_3$ $N_1$ | 5718 fg | 38.59 g | 101 gh | 1.03 e | 2.10 f |
| $I_3$ $N_2$ | 6326 ef | 44.75 e | 104 g | 1.10 cd | 2.20 e |
| $I_3$ $N_3$ | 9373 abc | 59.94 d | 124 e | 1.10 cd | 2.23 e |
| $I_3$ $N_4$ | 7382 d | 41.46 f | 132 d | 1.13 c | 2.30 e |
| $I_4$ $N_1$ | 6829 de | 33.87 hi | 132 d | 1.10 cd | 1.90 h |
| $I_4$ $N_2$ | 5763 fg | 27.91 j | 102 gh | 1.20 b | 2.10 f |
| $I_4$ $N_3$ | 6492 ef | 35.71 h | 120 e | 1.20 b | 2.07 f |
| $I_4$ $N_4$ | 5358 gh | 40.23 fg | 80 i | 1.20 b | 2.10 f |

Results proved that the performance of peanut without stress was significantly different form water stress condition. The comparison of mean data showed that the length of seed in $I_2$ treatment (average 2.61 cm) has a significant difference with $I_1$, $I_3$ and $I_4$ treatments (Table 4). The amount of nitrogen fertilizer applied show that there is no significant difference between $N_2$ (1.1cm) and $N_3$ (1.15cm) and a significant difference with $N_1$ (1.06cm) and $N_4$ (1.17cm). The harvest factor on N fertilizer did not have significant difference between $N_3$ and $N_4$ but were significant in the interactive comparison.

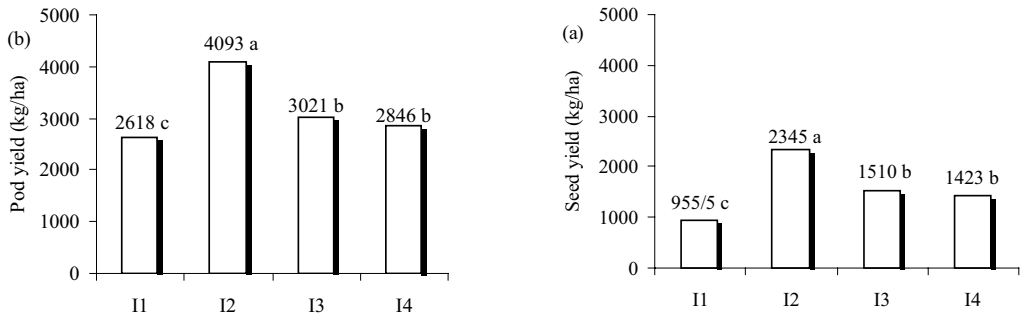


Fig 1. The relationship between irrigation management with seed yield (a) and pod yield (b) as influenced by various levels of irrigation.

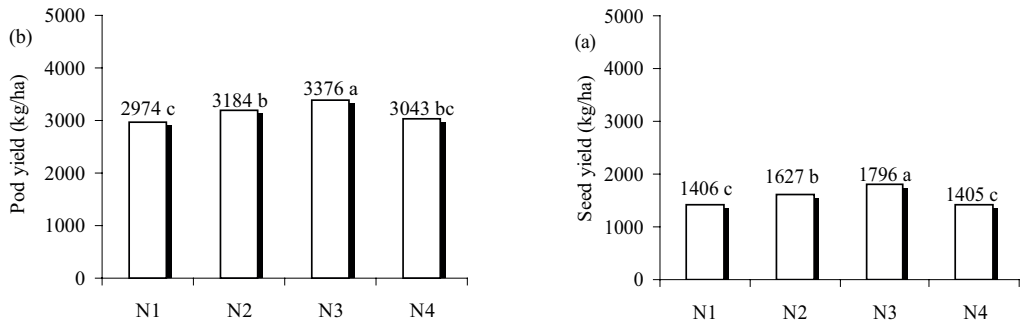


Fig 2. The relationship between irrigation management with seed yield (a) and pod yield (b) as influenced by various levels of Nitrogen fertilizer.

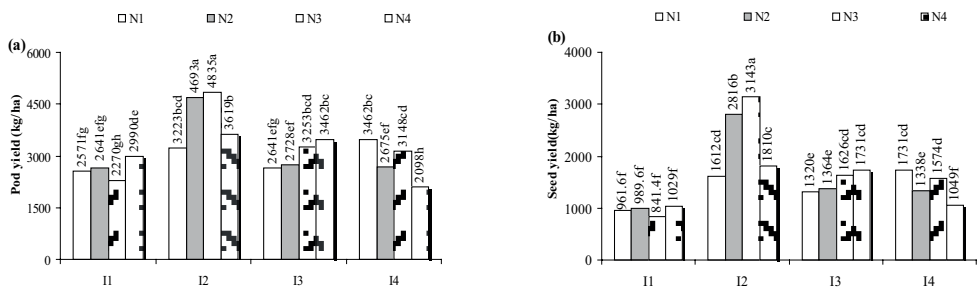


Fig 3. Pod yield (a) and seed yield (b) in Interaction conditions.

# 4. CONCLUSIONS

The Results of this investigation showed that with respect to irrigation management, the maximum yield for the seed was 6 day interval irrigation with pod yield 4093 and seed yield 2345 (kg/ha) among the amounts of N fertilizer also, the dose of 60 kgN/ha with pod yield of 3376 (kg/ha) and the seed yield of 1796 (kg/ha) were the highest.

# REFERENCES

Anonymous. 2005. Guilan Agriculture organization

Awal, M. W., and T. Ikeda, 2002: Recovery strategy following the imposition of Episodic soil moisture deficit in stands of peanut (Arachis hypogaea L.). J Agron. Crop Sci. 188, 185– 192.

Bell, M.J., R.C. Muchow and G.L. Wilson, 1987. The effect of plant population on peanut (Arachis hypogaea L.) in a monsoonal tropical environment. Field Crop Research. 17: 91- 107.

Craufurrd, P.Q, P.V. Vara and R.J. Summerfield, 2002. Dry matter production and rate of change of harvest index at height temperature in peanut. Crop Sci. 42:146-151.

El-Boraie, F.M. Abo-El-Ela, H.K and Gaber, A.M. 2009. Water Requirements of Peanut Grown in Sandy Soil under Drip Irrigation and Biofertilization. Australian Journal of Basic and Applied Sciences. 3(1): 55-65.

Giller, K. E., 2001: Nitrogen Fixation in Tropical Cropping Systems. CAB International, Wallingford.

Hungria, M., and M. A. T. Vargas, 2000. Environmental factors affecting N2 fixation in grain legumes in the tropics, with an emphasis on Brazil. Field Crops Res. 65, 151–164.

Haro, R. Dardanelli, J. Otegui, M and Collino, D. 2008. Seed yield determination of peanut crops under water deficit: Soil strength effects on pod set, the source sink ratio and radiation use efficiency. Field Crops Research. 109: 24-33.

Pallas, J. E. Jr., J. R. Stansell and T. J. Koske. 1979. Effects of drought on florunner peanuts. Agronomy Journal. 71:853-858.

Pimratch, S., S. Jogloy, N. Vorasoot, B. Toomsan, T.Kesmala, A. Patanothai and C.C. Holbrook, 2008. Effect of drought Stress on traits related to N2 fixation in eleven peanut (Arachis hypogaea L.) genotypes differing in degrees of resistance to drought. Asian J Plant Sci, 7. 334-342.

Rucker, K.S., Kvien, C.K, Holbrook, C.C. and Hook, J.E. 1995. Identification of peanut genotypes with improved drought avoidance traits. Peanut Sci. 22:14-18.

Songsri, P. Jogloy, S. Kesmala, T. Vorasoot, N. Akkasaeng, C. Patanothai, A and Holbrook,C .2008. Heritability of Drought Resistance Traits and Correlation of Drought Resistance and Agronomic Traits in Peanut. Crop Science Society of America. 48: 2245-2253.

Sinclair, T. R., A. A. Leilah, and A. K. Schreffler, 1995: Peanut nitrogen fixation (C2H2 reduction) response to soil dehydration. Peanut Sci. 16, 162–166.

Songsri, P., S. Jogloy, N. Vorasoot, C. Akkasaeng, A. Patanothai and C.C. Holbrook, 2008. Root distribution of drought-resistant peanut genotypes in response to drought J. Agron. Crop Sci., 194: 92-103.

Vorasoot, N. Songsri, P. Akkasaeng, C. Jogloy, S and Patanothai A. 2003. Effect of water stress on yield and agronomic characters of peanut (Arachis hypogaea L.). Songklanakarin J Sci Technol. 25(3): 283-288.

Vorasoot, N. Akkasaeng, C. Songsri, P. Jogloy, S and Patanothai A. 2004. Effect of available soil water on leaf development and dry matter partitioning in 4 cultivars of peanut (Arachis hypogaea L.) Songklanakarin J Sci Technol. 26(6): 787-794.