*Plant Archives* Vol. 20, Supplement 1, 2020 pp. 521-525 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

# EFFECT OF DAP, HUMIC ACID AND MICRONUTRIENT MIXTURE FOLIAR APPLICATION ON YIELD AND QUALITY CHARACTERS OF GROUNDNUT (*ARACHIS HYPOGAEA* L.) VAR. TMV 7 IN SANDY LOAM SOIL

**K. Swetha Reddy[1], R. Bhuvaneswari[2] and P.K. Karthikeyan[2]**
[1]Department of soil science and agricultural chemistry, Sri Krishna Devaraya college of Agricultural Sciences , Sri Balaji Educational Society, Anantpur- 515001. Andhra Pradesh, India.
[2]Department of Soil Science and Agricultural Chemistry, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Chidambaram, Tamil Nadu – 608002, India
E mail; 7995822s@gmail.com

## Abstract

A field experiment was conducted to study the effect of DAP, Humic acid and micronutrient mixture foliar application on yield and quality characters of groundnut var. TMV 7 in sandy loam soil. Groundnut plants were given foliar application viz., $T_2$–DAP 2.0%, $T_3$–Humic acid 0.3%, $T_4$–Micronutrient mixture 0.3%, $T_5$ – DAP 2.0% + Humic acid 0.3%, $T_6$ – DAP 2.0% + Micronutrient mixture 0.3%, $T_7$ – Humic acid 0.3% + Micronutrient mixture 0.3%, $T_8$ – DAP 2.0% + Humic acid 0.3% + Micronutrient mixture 0.3% along with control $T_1$. The results concluded that DAP, humic acid and micronutrient mixture foliar application records higher values for yield and quality characters viz., number of pods plant$^{-1}$, 100 kernel weight (test weight), shelling percentage, pod yield, haulm yield, kernel yield, oil content, oil yield and protein content over control.

***Keywords*** **:** Groundnut (var. TMV 7), Number of pods plant$^{-1}$, Pod yield, Haulm yield, Oil content, Protein content

## Introduction

Groundnut is the major oilseed crop of India. The groundnut kernel has dual advantage of being important as a source of edible oil as well as protein. It is native of Brazil (Aparna *et al.,* 2018). Nearly 75% of the groundnut is being cultivated in a low to moderate rainfall zone (Thulasiram *et al.,* 2018). Groundnut seeds are good source of vitamin E, calcium, phosphorus, magnesium, zinc, iron, riboflavin, thiamine and potassium. Oil extracted from the kernel is used for culinary purpose (Poonia *et al.,* 2018). The groundnut productivity was low due to improper nutrient management practices, low rainfall and low amount of nutrients in soil. Therefore foliar application helps in minimizing these constraints. Foliar application of nutrients constitutes one of the important milestones in the progress of agricultural production. Fertilizer applied to the soil at the time of sowing is not fully available to the plants as the crop approaches maturity (Meena *et al.,* 2017). The effectiveness of foliar applied nutrients is determined by the type of formulation and the time of application. Yield increase to an extent of 5-10 per cent (Sonawane *et al.,* 2010) can be achieved by using the right product at the right time. Humic acids increase the water infiltration and water holding capacity of the soil, increase plant root growth and metabolism and help plants deal with environmental stresses. The main benefit of humic acids in a liquid foliar application is that the plant will be able to uptake and utilize the nutrients in the solution many times more effectively than without the humates. Micronutrients are known to play many complex roles in plant development and health. Micronutrients promote the strong, steady growth of crops that produce higher yields and increase harvest quality and maximizing a plant's genetic potential. Micronutrient needs vary with the type of soil, crop planted and available nutrient source.

## Materials and Methods

A field experiment was conducted to study the effect of DAP, humic acid and micronutrient mixture foliar application on yield and quality characters of groundnut var. TMV 7. The experiment was conducted in a randomized block design (RBD) with the following eight treatments and replicated three times.

### Treatment details

- $T_1$ – Control
- $T_2$ – DAP 2.0%
- $T_3$ – Humic acid 0.3%
- $T_4$ – Micronutrient mixture 0.3%
- $T_5$ – DAP 2.0% + Humic acid 0.3%
- $T_6$ – DAP 2.0% + Micronutrient mixture 0.3%
- $T_7$ – Humic acid 0.3% + Micronutrient mixture 0.3%
- $T_8$ – DAP 2.0% + Humic acid 0.3% + Micronutrient mixture 0.3%

Recommended package of practices have been followed and nutrients applied to the crops at crop growth period. Five plants has been selected for recording observations. Number of pods in each sample plant was counted and the mean was expressed as number of pods plant$^{-1}$.Mean test weight of 100 grains per plot was recorded at 14 per cent moisture content and expressed in grams. The shelling percentage was calculated as per the formula given below.

$$\text{Shelling percentage} = \frac{\text{Weight of kernel}}{\text{Weight of pod}} \times 100$$

Fresh pods from each treatment plot were sun-dried for four days, weighed and expressed in kg ha$^{-1}$. The dry haulm yield from each plot at harvest was recorded after separating the pods and complete sun drying for a period of one week and haulm yield was worked out in kg ha$^{-1}$. The kernel yield was calculated as per the formula given below.

$$\text{Kernel yield (kg ha}^{-1}) = \frac{\text{Pod yield (kg ha}^{-1}) \times \text{Shelling \%}}{100}$$

The oil content of the kernel was estimated using diethylether as extractant by soxhlet's apparatus and expressed in percent (Gupta and Varshaney, 1989). Oil yield was calculated as per the formula given below.

$$\text{Oil yield (kg ha}^{-1}) = \frac{\text{Oil content (\%)}}{100} \times \text{Kernel yield (kg ha}^{-1})$$

Nitrogen content of kernel was estimated as per the procedure outlined in micro Kjeldahl method and the crude protein content of kernel was calculated by multiplying the percent nitrogen content of kernel with 6.25 (Piper, 1966). The data collection was analysed statistically which was given by Gomez and Gomez (1984).

## Results

The effect of DAP, humic acid and micronutrient mixture foliar application has significantly influenced the yield and quality characters and the results are furnished below.

**Number of pods**plant$^{-1}$, 100 kernel weight and shelling percentage

At harvest stage, the number of pods plant$^{-1}$ was significantly increased with the foliar application of HA. There was a significant increase in number of pods plant$^{-1}$with the combined application of DAP @ 2.0% + HA @ 0.3% + Mm @ 0.3%. The control recorded the minimum number of pods plant$^{-1}$. The maximum number of pods plant$^{-1}$ was recorded in the treatment $T_8$, which received DAP @ 2.0% + HA @ 0.3% + Mm @ 0.3% (23.00) succeeded by the treatments $T_5$>$T_7$> $T_3$ on par with $T_6$>$T_2$>$T_4$ recorded 21.95, 20.95, 19.98, 19.86, 18.81 and 17.66 respectively. The minimum number of pods plant$^{-1}$ recorded in control, $T_1$ (16.30). The foliar application of humic acid along with DAP and micronutrients did not showed any significant difference on 100 kernel weight and shelling percentage. However, the highest 100 kernel weight was noticed in the treatment $T_8$ (DAP @ 2.0% + HA @ 0.3% +Mm @ 0.3%) recorded 72.80 g, this was followed by $T_5$> $T_7$> $T_3$> $T_6$> $T_2$> $T_4$and the lowest 100 kernel weight was (68.30 g) recorded in Control ($T_1$). The maximum shelling percentage was noticed in the treatment $T_8$(DAP @ 2.0% + HA @ 0.3% + Mm @ 0.3%) recorded 72.20%, this was followed by the treatment $T_5$ (DAP @ 2.0% + HA @ 0.3%) recorded 71.79% and the minimum shelling percentage was noticed in control (69.60%).

**Pod, haulm and kernel yield**

Pod, haulm and kernel yield were significantly influenced with the foliar application of HA along with DAP and Mm. There was a significant increase in pod, haulm and kernel yield with the combined application of DAP @ 2.0% + HA @ 0.3% + Mm @ 0.3%. The control recorded the lowest yield. The treatment, $T_8$ which received the combined foliar spray of DAP @ 2.0% + HA @ 0.3% + Mm @ 0.3% twice at FS and PFS, registered the highest pod yield (2126 kg ha$^{-1}$) followed by $T_5$ (1962 kg ha$^{-1}$) > $T_7$ (1807 kg ha$^{-1}$) > $T_3$ (1656 kg ha$^{-1}$) > $T_6$ (1638 kg ha$^{-1}$) > $T_2$ (1474 kg ha$^{-1}$) > $T_4$ (1296 kg ha$^{-1}$) and the lowest pod yield was noticed in the treatment $T_1$ (1085 kg ha$^{-1}$). The highest haulm yield was found in the treatment $T_8$, which received DAP @ 2.0% + HA @ 0.3% + Mm @ 0.3% (3425 kg ha$^{-1}$) which was subsequently followed by $T_5$ (3161 kg ha$^{-1}$), $T_7$ (2912 kg ha$^{-1}$), $T_3$ (2667 kg ha$^{-1}$), $T_6$ (2639 kg ha$^{-1}$), $T_2$ (2375 kg ha$^{-1}$) and $T_4$ (2088 kg ha$^{-1}$). The lowest haulm yield was recorded in the treatment $T_1$ (1748 kg ha$^{-1}$). Among the various treatments, $T_8$ which received DAP @ 2.0% + HA @ 0.3% +Mm @ 0.3% noticed highest kernel yield (1534 kg ha$^{-1}$) next to this, $T_5$ (1408 kg ha$^{-1}$), followed by $T_7$ (1290 kg ha$^{-1}$), $T_3$ (1176 kg ha$^{-1}$), $T_6$ (1162 kg ha$^{-1}$), $T_2$ (1046 kg ha$^{-1}$), $T_4$ (908 kg ha$^{-1}$) and the lowest kernel yield (755 kg ha$^{-1}$) was recorded in the treatment $T_1$ (control).

**Oil content, oil yield and protein content**

There was no significant effect of the treatments on oil and protein content of groundnut, foliar application of humic acid along with DAP and micronutrients did not showed any significant difference on oil content and protein content. However, the highest oil content was noticed in the treatment $T_8$ (DAP @ 2.0% + HA @ 0.3% + Mm @ 0.3%) recorded 48.30%, subsequently followed by $T_5$> $T_7$> $T_3$> $T_6$> $T_2$> $T_4$ and the lowest oil content was (45.90%) recorded in Control ($T_1$). Among the various treatments, $T_8$ which received combined foliar application of DAP @ 2.0% + HA @ 0.3% + Mm @ 0.3% twice at flowering and peg formation stage, registered highest oil yield (740.92 kg ha$^{-1}$), followed by the treatments $T_5$ (DAP @ 2.0% + HA @ 0.3%) recorded 674.71 kg ha$^{-1}$, $T_7$ (HA @ 0.3%+ Mm @ 0.3%)noticed 613.65 kg ha$^{-1}$, $T_3$ (HA @ 0.3%) registered 555.30 kg ha$^{-1}$, $T_6$ (DAP @ 2.0% + Mm @ 0.3%) recorded 548.23 kg ha$^{-1}$, $T_2$ (DAP @ 2.0%) recorded 486.72 kg ha$^{-1}$ and $T_4$ (Mm @ 0.3%) which recorded 421.22 kg ha$^{-1}$ of oil yield and the lowest oil yield was 346.54 kg ha$^{-1}$, recorded in the treatment $T_1$ (control). The highest protein content was noticed in the treatment $T_8$ (DAP @ 2.0% + HA @ 0.3% + Mm @ 0.3%) recorded 22.48%, this was followed by the treatment $T_5$ (DAP @ 2.0% + HA @ 0.3%) recorded 22.06% and the lowest protein content was noticed in $T_1$ (19.80%).

## Discussion

The impact of the DAP, humic acid and micronutrient mixture foliar application on yield and quality characters of groundnut was discussed here as follows.

**Number of pods plant$^{-1}$, 100 kernel weight and shelling percentage**

Application of HA @ 0.3% significantly increased the yield attributes and yield of groundnut. This increase in number of pods plant$^{-1}$ and 100 kernel weight could be explained on the fact that the application of recommended dose of mineral fertilizers and humic acid foliar spray increased the uptake of nutrients by plants and consequently increased growth rate. The beneficial interaction effects of those fertilizers could be attributed to the enhancing of easily nutrients release into soil solution and to encourage their penetration through plant roots, as well as to develop antagonistic impacts towards pests and plant diseases (Ho and Hwan, 2000). In this concern, Salwa *et al.* (2010) recorded that humic acid helps to increase chlorophyll concentration in sesame plant which leading to higher degree of photosynthesis. This makes crops much green and leads to more accumulation to dry matter and subsequently increase the crop yield. Similar conclusion was also suggested by Nasef (2010) and Borhamy (2005). Foliar application of humic acid significantly increased the shelling percentage. It has been speculated that an increase in shelling percentage of groundnut might be due to that humic substances might have various biochemical effects either at cell wall, membrane level at in the cytoplasm which inturn result into enhanced photosynthesis. These results corroborate the findings of Rajpar *et al.* (2011) in mustard, El-Hak *et al.* (2012) in pea and Bakry *et al.* (2014) in flax. Application of DAP @ 2.0% had positive increase in yield attributes of groundnut. This could be attributed to increased translocation of photosynthates from leaves and stem to developing pods resulted in matured pods and bolder seeds. It was also evident from the data on leaf area duration that these foliar feedings treatments maintains leaf area for longer duration resulting in extended period of photosynthates translocation to developing seeds and hence recorded bolder seeds. Similar differences with respect to yield components were also reported earlier by Subrahmaniyan *et al.* (2000) and Chandrasekaran (2004). The increased yield attributes with the foliar feeding of micronutrients @ 0.3% was due to the fact that, improvement in photosynthesis and carbohydrate metabolism resulting into greater formation of photosynthetic and metabolites in source and later on translocated in the newly formed sinks which ultimately increased the yield parameters. These results are in agreement with the findings of Shivakumar and Kumutha (2003).

**Pod, haulm and kernel yield**

The pod haulm, yield were increased by 49% each and kernel yield by 56% with the foliar application of HA along with Mm and DAP over control. Foliar application of HA had a tremendous effect on yield of groundnut. The increase in pod, haulm and kernel yield was attributed to that, HA amplified permeability of cell membrane and thereby facilitated the enhance of potassium into the cell which accordingly raises the pressure inside the cell and cell division. On the other hand, increasing energy inside the cells would lead to chlorophyll production and photosynthesis rate increase. Then, the growth process is accelerated nitrogen absorption into the cells is intensified nitrate production is diminished and finally the production is improved (Giasuddin *et al.,* 2007). Moraditochaee (2012) in his experiment on peanut, obtained similar grain yield results in the presence of humic acid. DAP has a compelling effect on yield of groundnut crop. Foliar feeding of DAP @ 2.0% had significantly increased the pod, haulm and kernel yield. The pod yield is an end product, which obviously depends upon the total dry matter production at different stages of crop growth and its partitioning into reproductive parts for higher production. The improvement in the DMP may be due to the assimilation of nutrients supplied through the foliar application meeting the required nutrients demand of the crop during flowering period of groundnut. Foliar application resulted in greater absorption, assimilation and translocation of nutrients for increased photosynthesis. Increased production of dry matter and its efficient translocation to the economic parts ultimately reflected on the final yield. The role of foliar application of nutrients on physiology of crop plants is well established. Therefore, better availability and uptake of nutrients could be assigned as the proper reason for significant increase in dry matter production and its accumulation with foliar spray treatments (Shivakumar Malladada, 2005; Dalei *et al.,* 2014). The yield increase of groundnut due to micronutrients application is attributed to that, activation of various enzymes and increased basic metabolic rate in plants, facilitated the synthesis of nucleic acids and harmones, which inturn enhanced the yield due to greater availability of nutrients and photosynthates. These results are in agreement with those of Helpyati (2001) and Sumangala (2003).

**Quality characters**

It is more vivid that addition of HA improved quality parameters *viz.,* oil content, oil yield and protein content of groundnut crop. The oil yield increased by 53% with the combined foliar application of DAP + HA + Mm over control. The combine application of HA and Mm showed significant effect on quality parameters of groundnut. This increase can be attributed to chelate property of elements such as Na, K, Mg, Ca, Zn, Fe, Cu and other elements which compensates nutrient deficiency and as a result promotes quality and production (Verlinden *et al.,* 2009). Many researchers have claimed the oil and protein content increase in the presence of humic acid and micronutrients. Humic acid increased the protein content by improving the absorption of macro and micronutrients (Eneji *et al.,* 2013; Bahrani, 2015). Foliar application of DAP had significantly increased the quality parameters of groundnut. This might be due to the increased availability and use of phosphorus, it was a major constituent of fatty acids, higher accumulation of phosphorus might have resulted in higher kernel oil content. The results of present investigation are in conformity with the findings of Krishnappa *et al.* (1994).

## Conclusion

The present study concludes that impact of DAP @ 2.0% + HA @ 0.3% + Mm @ 0.3% foliar application was the best treatment by observing the highest yield and quality characters of groundnut. This increase was due to the improvement in photosynthesis and carbohydrate metabolism, micronutrients application is attributed to that, activation of various enzymes and increased basic metabolic rate and higher accumulation of phosphorus. Hence, the foliar application of DAP @ 2.0% + HA @ 0.3% + Mm @ 0.3% recommended for higher yield and quality characters in groundnut crop.

**Table 1 :** Effect of DAP, humic acid and micronutrient mixture foliar application on number of pods plant$^{-1}$, 100 kernel weight and shelling percentage of groundnut var. TMV 7

| Treatments | Pods plant$^{-1}$ | 100 Kernel weight (g) | Shelling percentage (%) |
|---|---|---|---|
| $T_1$ – Control | 16.30 | 68.30 | 69.60 |
| $T_2$ – DAP @ 2.0% | 18.81 | 69.98 | 70.57 |
| $T_3$ – HA @ 0.3% | 19.98 | 70.77 | 71.03 |
| $T_4$ – Mm @ 0.3% | 17.66 | 69.21 | 70.13 |
| $T_5$ – DAP @ 2.0% + HA @ 0.3% | 21.95 | 72.09 | 71.79 |
| $T_6$ – DAP @ 2.0% + Mm @ 0.3% | 19.86 | 70.69 | 70.98 |
| $T_7$ – HA @ 0.3% + Mm @ 0.3% | 20.95 | 71.42 | 71.41 |
| $T_8$ – DAP @ 2.0% + HA @ 0.3% + Mm @ 0.3% | 23.00 | 72.80 | 72.20 |
| **SED** | **0.34** | **0.23** | **0.13** |
| **CD (0.05)** | **0.72** | **NS** | **NS** |

HA – Humic acid; Mm – Micronutrient mixture

**Table 2 :** Effect of DAP, humic acid and micronutrient mixture foliar application on pod, haulm and kernel yield of groundnut var. TMV 7

| Treatments | Pod yield (kg ha$^{-1}$) | Haulm yield (kg ha$^{-1}$) | Kernel yield (kg ha$^{-1}$) |
|---|---|---|---|
| $T_1$ – Control | 1085 | 1748 | 755 |
| $T_2$ – DAP @ 2.0% | 1474 | 2375 | 1040 |
| $T_3$ – HA @ 0.3% | 1656 | 2667 | 1176 |
| $T_4$ – Mm @ 0.3% | 1296 | 2088 | 908 |
| $T_5$ – DAP @ 2.0% + HA @ 0.3% | 1962 | 3161 | 1408 |
| $T_6$ – DAP @ 2.0% + Mm @ 0.3% | 1638 | 2639 | 1162 |
| $T_7$ – HA @ 0.3% + Mm @ 0.3% | 1807 | 2912 | 1290 |
| $T_8$ – DAP @ 2.0% + HA @ 0.3% + Mm @ 0.3% | 2126 | 3425 | 1534 |
| **SED** | **53.11** | **85.56** | **39.74** |
| **CD (0.05)** | **111.54** | **179.68** | **83.46** |

HA – Humic acid; Mm – Micronutrient mixture

**Table 3 :** Effect of DAP, humic acid and micronutrient mixture foliar application on oil content, oil yield and protein content of groundnut var. TMV 7

| Treatments | Oil content (%) | Oil yield (kg ha$^{-1}$) | Protein content (%) |
|---|---|---|---|
| $T_1$ – Control | 45.90 | 346.54 | 19.80 |
| $T_2$ – DAP @ 2.0% | 46.80 | 486.72 | 20.80 |
| $T_3$ – HA @ 0.3% | 47.22 | 555.30 | 21.27 |
| $T_4$ – Mm @ 0.3% | 46.39 | 421.22 | 20.34 |
| $T_5$ – DAP @ 2.0% + HA @ 0.3% | 47.92 | 674.71 | 22.06 |
| $T_6$ – DAP @ 2.0% + Mm @ 0.3% | 47.18 | 548.23 | 21.22 |
| $T_7$ – HA @ 0.3% + Mm @ 0.3% | 47.57 | 613.65 | 21.66 |
| $T_8$ – DAP @ 2.0% + HA @ 0.3% + Mm @ 0.3% | 48.30 | 740.90 | 22.48 |
| **SED** | **0.12** | **20.12** | **0.14** |
| **CD (0.05)** | **NS** | **42.25** | **NS** |

HA – Humic acid; Mm – Micronutrient mixture

## References


Aparna, P.; Shanthi, M.P.; Reddy, D.M. and Latha, P. (2018). Estimation of genetic parameters in groundnut (*Arachis hypogaea* L.) for yield and it's contributing characters under inorganic fertilizer managements. Int. J. Curr. Microbiol. Appl. Sci., 7(4): 1559-1565.

Bahrani, A. (2015). Effect of some micro and macro nutrients on seed yield and oil content of rapeseed (*Brassica napus* L.). Int. J. Chem. Environ. Biol. Sci., 3(1): 71-74.

Bakry, A.B.; Taha, M.H.; Abdelgawad, Z.A. and Abdallah, M.M.S. (2014). The role of humic acid on growth, chemical constituents and yield quantity of three flax cultivars grown under saline soil conditions. Agric. Sci., 5: 1566-1575.

Borhamy, S.H.E.I. (2005). Effect of gypsum and mineral fertilizers on yield and nutrients concentration of peanut and wheat grown on sandy soil. Egypt J. Appl. Sci., 20(2): 328-339.

Chandrasekaran (2004). Effect of foliar application of DAP and $ZnSO_4$ on growth and productivity of groundnut. Int. J. Agric. Sci., 4(2): 548-550.

Dalei, B.B.; Kheroar, S.; Mohapatra, P.M.; Panda, S. and Deshmukh, M.R. (2014). Effect of foliar sprays on seed yield and economics of niger (*Guizotia abyssinica* L.). J. Agri. Sci.,6(6): 143-147.

El-Hak, S.H.G.; Ahmed, A.M. and Moustafa, Y.M.M. (2012). Effect of foliar application with two antioxidants and humic acid on growth, yield and yield components of peas (*Pisum sativum* L.). J. Horti. Sci. Ornamental Plants, 4(3): 318-328.

Eneji, A.E.; Islam, R.; An, P. and Amalu, U.C. (2013). Nitrate retention and physiological adjustment of maize to soil amendment with super absorbent polymers. J . Cleaner Prod., 52: 478-480.

Giasuddin, A.B.; Kanel, M.S. and Choi, H. (2007). Adsorption of humic acid onto nanoscale zerovalent iron and its effect on arsenic removal. Environ. Sci. Technol., 41(6): 2022-2027.

Gomez, K.A. and Gomez, A.A. (1984). Statistical procedures for agricultural research (Ed.) A Willey Inter Science Publication, New York, USA.

Gupta, A.K. and Varshaney, M.L. (1989). Practical manual for agricultural chemistry. Part II, I Ed. Kalyani Publishers, New Delhi, 35-37.

Helpyati, A.S. (2001). Effect of moisture regimes and zinc levels on the growth and yields of summer groundnut. Karnataka J. Agric. Sci., 14(2): 451-453.

Ho, H.O. and Hwan, J.K. (2000). The study on the plant growth hormones; in EM technology and nature farming. Sixth Inter. Conf., held in Kyusei, Pretoria, South Africa, 15-21.

Krishnappa, M.; Srinivas, C.N. and Santhy, P. (1994). Effect of macro and micronutrients on growth and yield in groundnut. Curr. Res., 23(1-2): 7-9.

Meena, D.; Bhushan, C.; Shukla, A.; Chaudhary, S. and Meena, S.S. 2017. Effect of foliar application of nutrients on biological yield and economics urdbean

(*Vigna mungo* (L.) Hepper). Int. J. Curr. Microbiol. Appl. Sci., 6(5): 2658-2662.

Moraditochaee, M. (2012). Effects of humic acid foliar spraying and nitrogen fertilizer management on yield of peanut (*Arachis hypogaea* L.) in Iran. *ARPN J. Agric. Biol. Sci.,*7(4): 289-293.

Nasef, M.A. (2010). Effect of gypsum, humic acid and ascorbic acid addition on properties of productivity of peanut crop under sandy soil conditions. J. Soil Sci. Agric. Engg., 1(2): 159-168.

Piper, C.S. (1966). Soil and plant analysis. Hans Publication, Bombay, 236.

Poonia, T.; Bhunia, S.R. and Choudhary, R. (2018). Effect of iron fertilization on nitrogen and iron content, uptake and quality parameters of groundnut (*Arachis hypogaea* L.). Int. J. Curr. Microbiol. Appl. Sci., 7(3): 2297-2303.

Rajpar, M.B.; Zia-Ul-Hassan, B.; Shah, A.N. and Tunio, S.D. (2011). Humic acid improves growth, yield and oil content of *Brassica compestris* L. Pak. J. Agr. Agril. Engg. Vet. Sci., 27(2): 125-133.

Salwa, A.I.; Eisa, M.; Mohsen, A. and Behary, S.S. (2010). Amelioration productivity of sandy soil by using amino acids, sulphur and micronutrients for sesame production. J. Am. Sci., 6(11): 250-257.

Shivakumar, U.I. and Kumutha, K. (2003). Effect of rhizobium and molybdenum on nodulation yield and yield contributing characters of groundnut. J. Echobiol., 15: 451-455.

Shivakumar, M. (2005). Effect of amendification with fly ash, fertilizer levels and foliar nutrition on NPK on growth and yield of groundnut and soil properties. M.Sc. (Ag.) Thesis, Univ. Agric. Sci., Dharwad, Karnataka, India.

Sonawane, B.B.; Nawalkar, P.S. and Patil, V.D. (2010). Effect of micronutrients on growth and yield of groundnut. J. Soils Crops, 20(2): 269-273.

Subrahmaniyan, K.; Kalaiselvan, P. and Arulmozhi, N. (2000). Studies on the effect of nutrient spray and graded level of NPK fertilizers on the growth and yield of groundnut. Int. J. Trop. Agric., 18(3): 287-290.

Sumangala, B.J. (2003). Response of groundnut (*Arachis hypogaea* L.) to conjunctive use of micronutrients and bio-inoculants at graded levels of fertilizers under dry land conditions. Ph.D. Thesis, Univ. Agric. Sci., Dharwad, Karnataka, India.

Thulasiram, R.; Alagumani, T.; Raman, M.S. and Parthasarathi, G. (2018). Resource-use efficiency of groundnut cultivation in Tamil Nadu. Int. J. Curr. Microbiol. Appl. Sci., (6): 351-357.

Verlinden, G.; Pycke, B.; Mertens, J.; Debersaques, F.; Verheyen, K.; Baert, G.; Bries, J. and Haesaert, G. (2009). Application of humic substances results in consistent increases in crop yield and nutrient uptake. J. Pl. Nutri., 32: 1407-1426.