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Research Article

RESPONSE OF PEANUT *(ARACHIS HYPOGAEA* L.*)* TO THEIR INTEGRATED BIOFERTILIZER, CHEMICAL NITROGEN FERTILIZER AND PLANT DENSITY

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ABSTRACT
In order to determine response of peanut to their integrated biofertilizer, chemical nitrogen fertilizer and plant density, a field experiment was conducted using factorial in randomized complete block design with three replications in 2012 growing season at Astaneh Ashrafiyeh, North of Iran. The factors of experiment consisted of plant density (20×20 cm, 30×30 cm and 40×40 cm) and different levels of chemical nitrogen fertilizer (N1=0, N2= Azospirillum + Azotobacter, N3= 30 kgN/ha + Aazospirillum + Azotobacter, N4= 60 kgN/ha + Aazospirillum + Azotobacter and N5= 90 kgN/ha + Aazospirillum + Azotobacter). The results of this investigation showed that seed yield, pod yield and biomass yield traits were significantly affected by integrated bio-fertilizer and different levels of chemical nitrogen fertilizer and plant density. The highest seed yield were found in 40×40 cm plant density (1604 kg/ha) and application of 30 kg N/ha + Aazospirillum + Azotobacter (1751 kg/ha). The highest pod yield were found at 40×40 cm plant density (2748 kg/ha) and on application of 30 kg N/ha + Aazospirillum + Azotobacter (3006 kg/ha). The highest pod yield were found at 40×40 cm plant density (10500 kg/ha) and on application of 90 kg N/ha + Aazospirillum + Azotobacter (10788 kg/ha).

Keywords: *Fertilizer, Plant density, Yield, Peanut.*

INTRODUCTION
Peanut is one of the most important and economical oilseeds in tropical and subtropical regions which is mostly grown due to its oil, protein and carbohydrates (Panhwar, 2005). It is an annual shrub of Leguminosae family and Arachis genus which has a main straight root (Panjtandoust, 2008). The peanut seed is rich in edible oil and contains 43-55% oil and 25-28% protein (Maiti, and Ebeling, 2002). Supplying nutrients for plants in a normal way is essential to reach an optimum yield in agricultural production (Karimi *et al.*, 2007). Peanut is taken as an oil plants. Guilan province is one of the major peanut producing provinces in Iran was provided from this province. In Guilan, it is mostly planted in Astaneh Ashrafiyeh and also along Sepidroud river margin (Azarpour *et al.*, 2012). Due to limited arable land in Iran, the best way to increase peanut production is enhancing the performance (yield) in per unit of under-cultivated area by using different farming methods. Using proper planting density for peanut can increase the yield of pods. Selecting optimal bush density according to the climate of the region may cause better establishment, effective use of light, food and environmental factors. Bush density not only determines the competition for light and nutrients but also controls the division of dried materials between the organs and ultimately increases the yield (Rasekh *et al.*, 2009). Suitable plants densities for optimum leaf growth by controlling water, fertilizer and chemical inputs is essential for improving the growth variables responsible for high yield. Optimum plant spacing ensures the plants to grow properly both in their aerial and underground parts through different utilization of solar radiation and nutrients. When the plant density exceeds an optimum level, competition among plants for light above ground or for nutrients below the ground become severe, consequently the plant growth slows down and the grain yield decreases (Hasanuzzaman *et al.*, 2009; Moradi and Azarpour, 2011).
Nitrogen has a critical role in producing agricultural products and selecting the amount of nitrogen-containing fertilizers is necessary for having the highest production level. Absorption of adequate amounts of nitrogen by

a plant leads to more protein content and larger cereal and legume seeds. Generally, the more the concentration of nitrogen in leaves, the more the intensity of carbon-making would be because aside from being found as protein in plants, nitrogen is the main element in the chlorophyll synthesis and its fixation could lead to more growth of aerial parts. Usually, nitrogen shortage is observed when plant nutrition is not managed properly and this element is not provided in adequate amounts, which could result in the older leaves to turn yellow and eventually, the plant's growth stops. In other cases, when too much nitrogen is provided for the plant, it normally leads to watering of protoplasm and brittleness of the plant itself which would result in becoming vulnerable to diseases and pests (Davoodi, 2007). Use of soil microorganisms which can whether fix atmospheric nitrogen or solubilize phosphates or synthesis of growth promoting substances or by enhancing the decomposition of plant residues to release vital nutrients and increase humic content of soils, will be environmentally begin approach for nutrient management and ecosystem function (Wu *et al.*, 2005). Effect of inoculation on soil: Soils are one of the most important resources a farmer has. Soil health is fundamental to profitable and sustainable production and most important resource we use in agriculture. Proper management of the soil is a key to plant health and crop productivity. Soil structure has a strong impact on a range of processes in xuencing crop yield. It refers to the manner and stability with which individual sand, silt, and clay particles are bound together into units called aggregates. Soil aggregation is an important characteristic of soil fertility. Aggregates determine the mechanical and physical properties of soil such as retention and movement of water, aeration, and temperature. Aggregate formation is an important factor controlling germination and root growth (Rhawhia *et al.*, 2010).

The aim of current study was study effects of their integrated biofertilizer and chemical nitrogen fertilizer and plant density on yield of peanut in north Iran condition.

MATERIALS AND METHODS

In order to determine response of peanut to their integrated biofertilizer and chemical nitrogen fertilizer and plant density, a field experiment was conducted using factorial in randomized complete block design with three replications in 2012 growing season Astaneh Ashrafiyeh, North of Iran. The factors of experiment was consist of plant density (20×20 cm, 30×30 cm and 40×40 cm) and different levels of chemical nitrogen fertilizer (N1=0, N2= Azospirillum + Azotobacter, N3= 30 kgN/ha + Aazospirillum + Azotobacter, N4= 60 kgN/ha + Aazospirillum + Azotobacter and N5= 90 kgN/ha + Aazospirillum + Azotobacter) was performed. Based on soil analysis (Table 1), phosphorous and potash fertilizer were applied for all treatments. The location of experiment was showed in Figure ure 1. To determine the total biomass (dry matter) at maturity, after excluding two rows on both sides in each plot, 12 plants were randomly selected. Then, pods, leaves and stems were placed in a 70ºC oven for 48 hours. When dried, initially, mature pods' weight for each plant was measured by the ratio of mature pods weight to the number of mature pods per 12 plants. To estimate seed and pod yields, after the exclusion of two rows on the sides, mature pods and seeds were weighed using an accurate laboratory scale. To analyze the variance of data and to compare the mean values (Duncan test at the probability level of 5%), SAS software.

Table 1: Physical and chemical properties of experimental filed soil

Soil characteristics	Amount
Sand (%)	35.5
Silt (%)	44
Clay (%)	20.5
Soil texture	Loam
pH	7.5
Nitrogen (%)	0.02
Phosphorus (%)	39.19
Potassium (%)	340.53
EC (ds m^{-1})	8.5

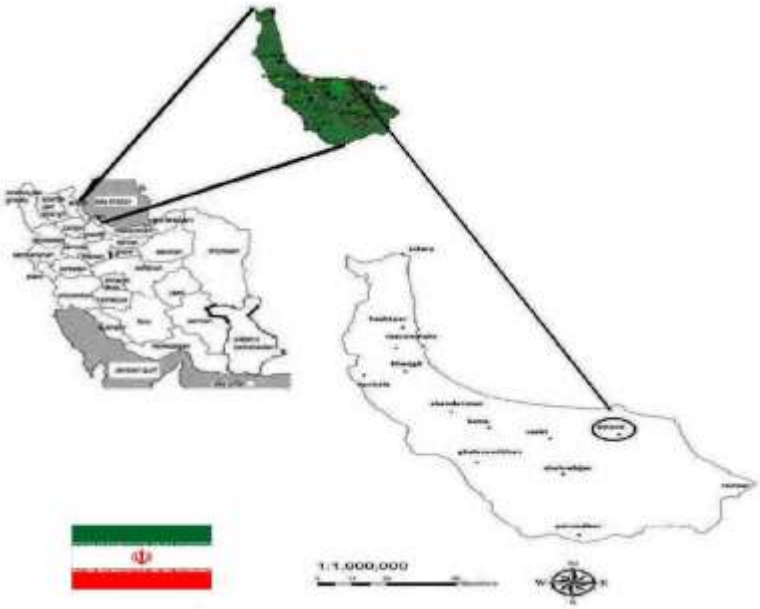

Figure 1: The location of experiment site

Table 2: Results of variance analysis for effects of plant density, bio-fertilizers and different levels of chemical nitrogen fertilizer on yield of peanut

S.O.V	DF	Seed Yield	Pod yield	Biomass yield
Replication (R)	2	87314.489	387361.156	11305595
Plant density (D)	2	239719.822**	736088.789**	34639478.2**
Nitrogen + Bacteria (N)	4	394758.889**	1512828.67**	26277696**
D×N	28	366.322	1044.717	17034.7
Error		15021.798	519160.806	678382
CV		8.5	7	9.5

Table 3: Comparison of mean about the effects of plant density, bio-fertilizers and different levels of chemical nitrogen fertilizer on yield of peanut

S.O.V	Seed Yield (Kg/ha)	Pod Yield (Kg/ha)	Biomass yield (Kg/ha)
Plant density (D)			
D_1	1352C	2305C	7483C
D_2	1493B	2521B	8673B
D_3	1604A	2748A	10500A
Nitrogen + Bacteria (N)			
N_1	1229C	2026E	6822C
N_2	1320C	2207D	7357C
N_3	1751A	3006A	9558B
N_4	1582B	2824B	9911B
N_5	1534B	2561C	10778A

Within each column, means followed by the same letter do not differ significantly at $P<0.05$

RESULTS AND DISCUSSION

With attention to variance analysis table (Table 2), the effects of plant density, bio-fertilizers and different levels of chemical nitrogen fertilizer on seed yield of peanut was significant at 1% probability level. Among plant density levels the highest seed yield with 1604 kg/ha was obtained by D3 level (40×40 cm).

On the other hand, the lowest seed yield was recorded from D1 level (20×20 cm) treatment with 1352 kg/ha (Table 3). Among bio-fertilizers and different levels of chemical nitrogen fertilizer application levels the highest seed yield with 1751 kg/ha was obtained by consumption of 30 kg N/ha + Aazospirillum + Azotobacter. On the other hand, the lowest seed yield were recorded from control (without fertilizer application) treatment with 1229 kg/ha and 0 kg N/ha + Aazospirillum + Azotobacter treatment with 1320 kg/ha (Table 3). Moradi *et al.,* (2012) and Rasekh *et al.,* (2009) same result were reported.

With attention to variance analysis table (Table 2), the effects of plant density, bio-fertilizers and different levels of chemical nitrogen fertilizer on pod yield of peanut was significant at 1% probability level. Among plant density levels the highest pod yield with 2748 kg/ha was obtained by D3 level (40×40 cm). On the other hand, the lowest pod yield was recorded from D1 level (20×20 cm) treatment with 2305 kg/ha (Table 3). Among bio-fertilizers and different levels of chemical nitrogen fertilizer application levels the highest pod yield with 3006 kg/ha was obtained by consumption of 30 kg N/ha + Aazospirillum + Azotobacter. On the other hand, the lowest pod yield was recorded from control (without fertilizer application) treatment with 2026 kg/ha (Table 3). Moradi *et al.,* (2012) and Rasekh *et al.,* (2009) same result were reported.

With attention to variance analysis table (Table 2), the effects of plant density, bio-fertilizers and different levels of chemical nitrogen fertilizer on biomass yield of peanut was significant at 1% probability level. Among plant density levels the highest biomass yield with 10500 kg/ha was obtained by D3 level (40×40 cm). On the other hand, the lowest biomass yield was recorded from D1 level (20×20 cm) treatment with 7483 kg/ha (Table 3). Among bio-fertilizers and different levels of chemical nitrogen fertilizer application levels the highest biomass yield with 10778 kg/ha was obtained by consumption of 90 kg N/ha + Aazospirillum + Azotobacter. On the other hand, the lowest biomass yield were recorded from control (without fertilizer application) treatment with 6822 kg/ha and 0 kg N/ha + Aazospirillum + Azotobacter treatment with 7357 kg/ha (Table 3). Moradi *et al.,* (2012) and Rasekh *et al.,* (2009) same result were reported.

Plant density and planting pattern are major cause of inability to achieve potential yield in irrigated and dry land production (Bell *et al.,* 1991). The response of peanuts to plant density has been investigated in many areas of the world. Investigation of growth and yield performance of peanut (Arachis hypogaea L.) with special reference to arrangement by Auma has been conducted. The results have showed that leaf area index, crop growth rate, pod growth rate and pod and kernel yields have increased by the square planting pattern (Jaffar and Gardner, 1988). Kvien et al. (1988) reported that increasing plant density from 2-20 plants m-2 increased LAI from 2.2-4.8 and 3.5-5.7 for florunner and Southern runner cultivars, respectively. Pod yield also has increased from 310-580 and 190-550 g m-2 for florunner and Southern runner, respectively (Kvien *et al.,* 1988).

Plant growth promoting rhizobacteria (PGPR) are a group of bacteria that actively colonize plant roots and increase plant growth and yield. The action mechanisms of PGPRs can be divided into direct and indirect ones. Direct mechanisms include N2 fixation, soil mineral solubilization, production of plant-growth-promoting substances (auxins, cytokinins or gibberellins) and reduction of ethylene levels, among others. Indirect mechanisms include favoring colonization by other beneficial soil microorganisms, such as mycorrhizal fungi, and repressing the growth of plant pathogenic microorganisms (Lugtenberg *et al.,* 2009; Marulanda *et al.,* 2010; Gholami *et al.,* 2009). Biofertilizer microorganisms are more suitable for high crop yield, protection from different pathogens and pesticides. They also help in maintaining soil health by decomposition of dead and decaying matters in the soils (Verma *et al.,* 2010). The ability of many rhizobacteria to produce plant hormones or hormone-like substances has often been evoked to explain how PGPR can promote plant growth (Jaleel *et al.,* 2007). Yasari et al. (2008) reported that the application of Azotobacter and Azospirillum helped increase the oil content of canola seeds. Azotobacter along with other N2 -fixing bacteria like rhizobium play an important role in yield-attributed characters owing to the production of siderophores which regulate the availability of nutrients to the crop (Boiero *et al.,* 2007).

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