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# The Effect of Nitrogen on Seed and Oil Yield of Seven Sesame (*Sesamum indicum* L.) Genotypes in Isfahan

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## ABSTRACT

Nitrogen is a major part of plant nutrition in agricultural ecosystems. It greatly affects the yield of crops, specially "oilseed crops" such as sesame. In order to study the effect of nitrogen and genotype on the seed and oil yield of sesame; an experiment was laid out in split plots based on randomized complete block design with three replications and 35 plants $m^{-2}$ at the Lavark Research Farm, Isfahan University of Technology, in 2006. Three nitrogen levels (50, 100 and 150 Kg N $ha^{-1}$) and seven sesame genotypes (Local Ardestan, Nonbracching Naz, Branching Naz, Yekta, Oltan, Darab 14 and Varamin 2822) were used in main and sub plots, respectively. With an increase in nitrogen application to at least 150 kg N $ha^{-1}$, despite a decrease in oil content, the seed and oil yield increased ($P \leq 0.01$) averaged over genotypes. Since Yekta and Oltan outyielded the rest of genotypes, the latter genotypes with application of at least 150 kg N $ha^{-1}$ could be recommended for sesame production in Isfahan.

**Key Words:** *Sesamum indicum* L., fertility, nutrient, nitrogen, yield, oil

## INTRODUCTION

Sesame (*Sesamum indicum* L.) possesses the highest oil content (nearly 50% of seed weight) among all oilseed crops (Wiess, 2000). However, according to FAO statistics in 2006, the seed yield of sesame in Iran was only 700 Kg $ha^{-1}$ against maximum seed yield potential of around 3000 Kg $ha^{-1}$ for irrigated farming (FAO, 2008). Besides low soil fertility, one of the most important reasons of low seed yield is unsufficient nutrient applications such as nitrogen (Wortmann et al., 2007; weiss, 2000). Nitrogenous fertilizers are among the most essential parts of plant nutrition in agricultural ecosystems and crop production. They extremely affect the physiological processes, plant functions and yield of crops (Addiscott, 2005).

Most of farmers believe that sesame does not respond well to the fertilizers (Tadele, 2005; Wiess, 2000). In addition, it is believed that nitrogen application declines economic yield of oilseeds via reducing the seed oil content. But, according to some reports sesame seed yield could be raised by 50% with proper fertilization (Prakasha & Gowda, 1992).

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**Abbreviations:** EC: electrical conductivity, OM: organic matter, OC: organic carbon.

There is little information concerning sesame response to nitrogen application. Hence, this investigation was planned in order to determine the best nitrogen level and genotype for achieving a higher seed and oil yield of sesame in Isfahan.

## MATERIALS and METHODS

The study was conducted at the Lavark Research Farm, Isfahan University of Technology (lat. 32°: 32' N, long. 51°: 23' E and 1630 m) during May to October, 2006. The soil was fine-loamy, mixed, thermic Typic Haplargids with pH: 7.6, EC: 0.07 S $m^{-1}$, OM: 0.23%, OC: 0.13% and 0.15: 7.2: 150 mg $Kg^{-1}$ available N: P: K.

The experiment was laid out in split plots based on randomized complete block design with three replications. Three nitrogen levels including 50, 100 and 150 Kg N $ha^{-1}$ as the urea form with 46% nitrogen and seven sesame genotypes including one local population from the region known as Local Ardestan; besides six hopeful breeded lines (cultivars) called Nonbranching Naz, Branching Naz, Yekta, Oltan, Darab 14 and Varamin 2822 (Seed and Plant Improvement Institute, Karaj, Iran) were used in main and sub plots, respectively. The plant density was 35 plants $m^{-2}$. One third of each nitrogen level was applied as the starter before sowing, while the second and third parts were dressed at seedling and early flowering phases, respectively.

The seed oil content was measured with soxhlet method following AOAC guide (AOAC, 2002) and the seed yield was corrected for 7% moisture content according to the standard water content for sesame seed in Iran, No. 3460 (ISIRI, 1994). The oil yield was calculated by multiplication of corrected seed yield and seed oil content. All statistical analyses were performed using the GLM procedure in SAS 9.1.3 package (SAS Institute Inc., Cary, NC). Treatment means were separated by LSD test at the P=0.05 level.

## RESULTS and DISCUSSION

### Seed Yield

Increasing nitrogen application significantly enhanced the seed yield of sesame (Table 1). This enhancement was, probably, achieved by a delay in photosynthetic organs senecence and an enhancement in chlorophyll and enzyme contents such as rubisco, which led to the more photosynthesis and assimilation. Schlemmer et al. (2005) suggested leaf available nitrogen content has a direct and proportional impact on leaf chlorophyll content and nutrients affect the chloropyll content of the leaf. In Sesame (Mujaya & Yerokan, 2003), safflower (Gawand et al., 2005) and soybean (Osborne & Riedell, 2006; Ray et al., 2006), a higher significant seed yield was obtained with the enhancement of nitrogen rate. Osborne and Riedell (2006) reported the increase could be due to an increase in early plant biomass and the possetive impact of nitrogen fertilizer on the early plant biomass. In this case, Yekta and Oltan indicated the highest seed yield among all genotypes, while Local Ardestan and Branching Naz demonstrated the lowest (Table 1).

Table 1. Mean seed yield, seed oil content and oil yield as influenced by various treatments.†

| Treatment | Seed yield (Kg ha$^{-1}$) | Seed oil content (%) | Oil yield (Kg ha$^{-1}$) |
|---|---|---|---|
| Nitrogen fertilizer (Kg N ha$^{-1}$) | | | |
| 50 | 1410.95 $^{c}$ | 57.93 $^{a}$ | 830.20 $^{c}$ |
| 100 | 2078.90 $^{b}$ | 49.54 $^{b}$ | 1051.62 $^{b}$ |
| 150 | 2590.67 $^{a}$ | 45.39 $^{c}$ | 1203.19 $^{a}$ |
| Genotype | | | |
| Local Ardestan | 1189.24 $^{c}$ | 35.29 $^{d}$ | 408.95 $^{e}$ |
| Nonbranching Naz | 2103.55 $^{b}$ | 55.97 $^{a}$ | 1153.19 $^{b}$ |
| Branching Naz | 1241.54 $^{c}$ | 55.72 $^{a}$ | 682.76 $^{d}$ |
| Yekta | 2734.83 $^{a}$ | 56.15 $^{a}$ | 1509.96 $^{a}$ |
| Oltan | 2862.52 $^{a}$ | 51.90 $^{b}$ | 1454.39 $^{a}$ |
| Darab 14 | 2037.90 $^{b}$ | 51.72 $^{b}$ | 1015.01 $^{c}$ |
| Varamin 2822 | 2018.28 $^{b}$ | 49.93 $^{c}$ | 974.11 $^{c}$ |

† In each column, means with the same letters are not significantly different by LSD test at $P \leq 0.05$.

Generally, Yekta with 150 Kg N ha$^{-1}$ implied the highest seed yield, whereas Local Ardestan and Bbranching Naz with 50 Kg N ha$^{-1}$ exhibited the lowest (Figure 1).

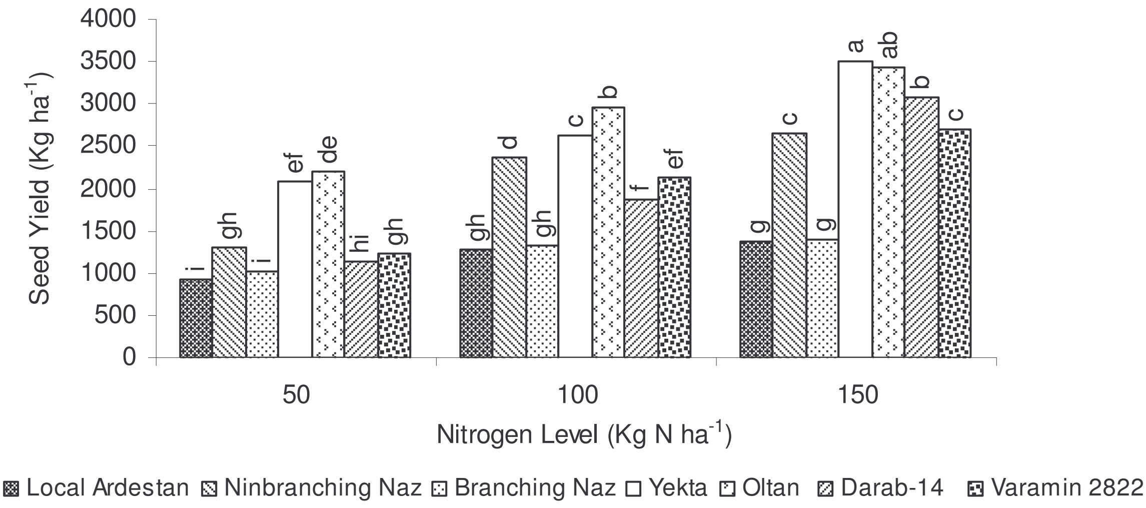


Figure 1. Seed yield of sesame genotypes influenced by nitrogen levels.

**Seed Oil Content**

Increasing nitrogen level significantly decreased the seed oil content. This decrease might have been resulted from an increase in allocation of assimilates into amino acid, protein and enzyme production in response to nitrogen application (Table 1). These sort of alterations have been reported in other oilseed crops such as soybean (Osborne & Riedell, 2006); safflower (Abbadi et al., 2008; Gawand et al., 2005) and sunflower (Abbadi et al., 2008). However, Mujaya and Yerokan (2003) did not observe any significant differences among sesame oil contents with increasing nitrogen level up to 90 Kg N ha$^{-1}$. Among the genotypes, the highest oil content extracted from Nonbranching Naz, Branching Naz and Yekta, whilst the lowest one was observed in Local Ardestan (Table 1).

In general, the gretast and smallest oil content of the seed were determined in Nonbranching Naz, Branching Naz and Yekta under 50 Kg N ha$^{-1}$ and Local Ardestan under 150 Kg N ha$^{-1}$, respectively (Figure 2).

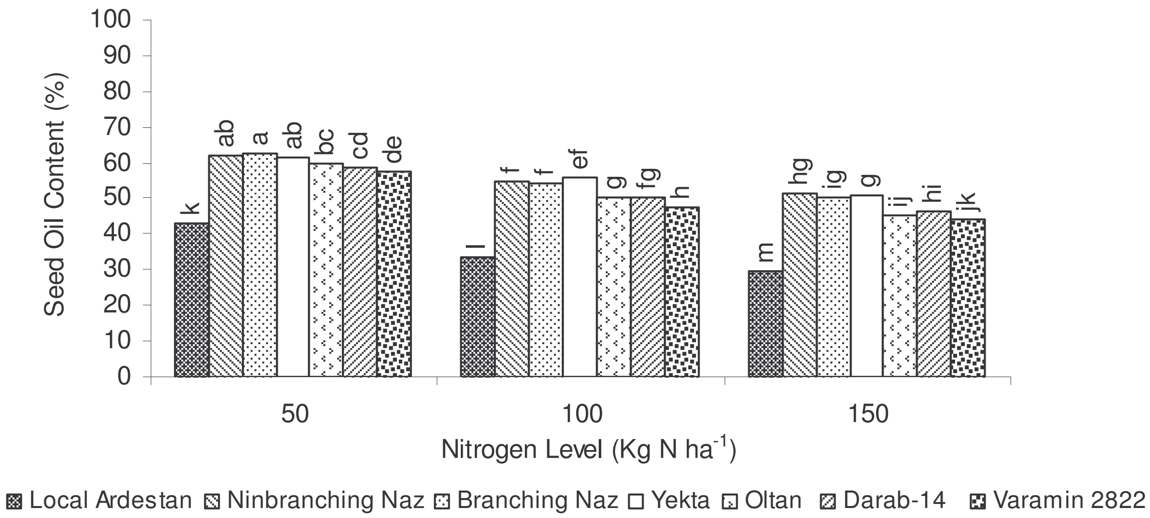


Figure 2. Oil content of sesame genotypes influenced by nitrogen levels.

**Oil Yield**

Although seed oil content was decreased, oil yield showed a significant enhancement (Table 1).

This is indicative of the fact that oil yield is more affected by seed yield than seed oil content. Mujuya and Yerokan (2003) stated that more oil could be obtained only by increasing seed yield. As a result, increasing nitrogen application will raise oil yield in addition to seed yield. Abbadi et al. (2008) in safflower and sunflower and Gawand et al. (2005) in safflower reported the same results with increasing nitrogen application. The highest oil yield was determined in Yekta and Oltan while the lowest one was detected in Local Ardestan and Branching Naz (Table 1).

Overall, the highest and lowest oil yield were obtained with Yekta at 150 Kg N ha$^{-1}$ and Local Ardestan at all nitrogen levels, respectively (Figure 3).

Our results indicate that sesame responds well to nitrogen application and if appropriate cultivars with sufficient nitrogen levels are used, a high economic yield will be obtained. In cunclusion, because Yekta and Oltan outyielded the rest of genotypes, they could be recommended for sesame production with application of at least 150 kg N ha$^{-1}$ in Isfahan.

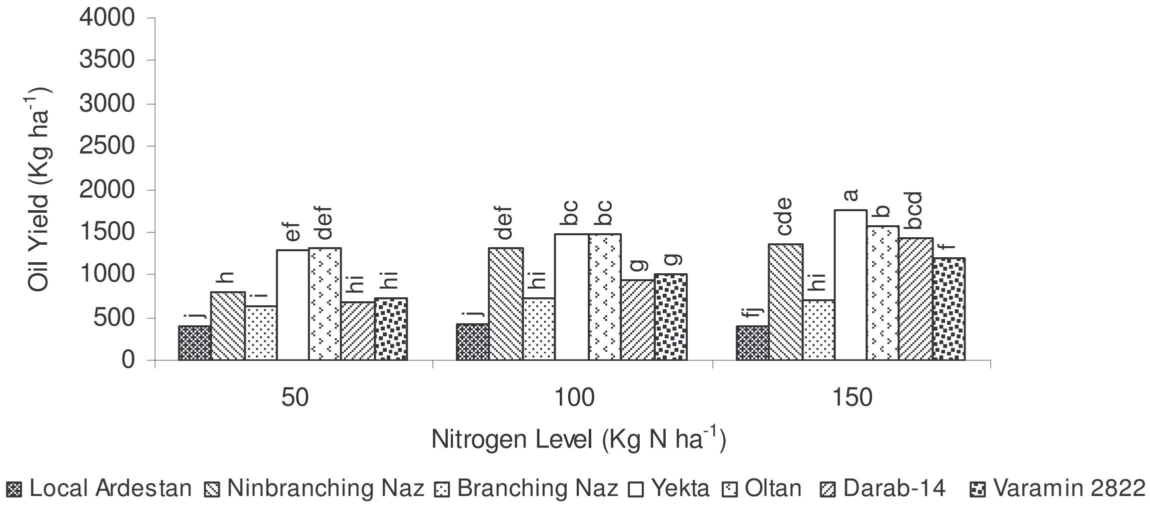


Figure 3. Oil yield of sesame genotypes influenced by nitrogen levels.

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