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# The Effect of Stem Pruning and Nitrogen Levels of on Some Physico-Chemical Characteristics of Pumpkin Seed (*Cucurbita pepo* L.)

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**Abstract:** To investigate the effects of stem pruning (No heading, head pruning of stem after formation of 10 and 14 nodes) and nitrogen levels (0, 50, 100 and 200 kg $ha^{-1}$) on physical and chemical characteristic of pumpkin seed a Factorial experiment based on randomized complete block design with three replication was carried out in Gorgan at 2003 and repeated in 2004 years. Results showed that the stem pruning has significant effect on traits such as seed oil, linoleic acid and oleic acid content. Nitrogen levels also have significant effect on seed dimension, seed oil, linoleic acid and oleic acid content. The largest amount of oil and linoleic acid content was obtained by stem pruning after forming 14 node and 100 kg $ha^{-1}$ nitrogen in separately, but the interaction of treatments were not significant difference for all of traits.

**Key words:** Fatty acids, oil content, pumpkin, seed, head pruning

## INTRODUCTION

Common pumpkin (*Cucurbita pepo* L.) is an important annual plant belongs to the cucurbitaceae family. It has a sprawling prickly stem, about 300-500 cm long. The leaves are large, orange-yellow in color; male flowers appear in leaf axils and the female flowers on stalks. The fruits are green to orange. The root systems are fibrous (Bernath, 1993; Robinson and Decker-Walters, 1997).

Pumpkin has been used as a vegetable and medicine since ancient times, but has been cultivated as a medicinal plant only in recent decades (Kuhlmann *et al*., 1993).

The seeds of pumpkin contain fatty acid oil, especially of the linoleic acid, β-sitostrol and E-vitamin is used as draw material for certain pharmaceutical products including Peponen®, Pepostrin® and Gronfing® capsules which are mainly used to cure the prostatic hypertrophy and urinary tract irritation (Horvath and Bedo, 1988, Bremness, 1994).

Pumpkin with small fruits is favored for seed production (Berenji and Popp, 2000). Murkovich *et al*. (1997) demonstrated that flat and thick seeds have higher oil content and the oil content of the seed increased with increase of fruit ripening period.

The growth of plants and other factors can be modified by pruning to suit human needs and desires (Jarrick, 1986).

Nitrogen is a critically important nutrient in pumpkin production, both from a seed yield and a maturity perspective. While too little N can result in reduced fruit size and low yields, excess N can delay flowering, causing high amounts of green fruit at harvest at the expense of ripe fruit production (Swiader *et al*., 1994).

This experiment was carried out to determine the effects of pruning and N levels on oil content, fatty acids oil and dimension of seed pumpkin.

## MATERIALS AND METHODS

In order to study the effects of head pruning and nitrogen fertilizer on some physico-chemical properties of the pumpkin seeds a factorial experiment based on randomized Complete Block design with three replication was carried out at Gorgan in 2003 and 2004. The climatic information and some of soil physico-chemical properties in experimental field are shown in Table 1 and 2, respectively. Gorgan has a Caspian temperate climate. The soil texture is silty loam which characterized by low organic-matter content (≈0.25) and low nutrient-holding capacity (EC≈2.2 meq/100 g).

The factors include head pruning (No heading, head pruning of stem after formation of 10 and 14 nodes) and

Table 1: Climatic elements in research field

| Elements | Year | Apr. | May | Jun. | Jul. | Aug. | Sep. |
|---|---|---|---|---|---|---|---|
| Sundial (h) | 2003 | 68.40 | 240.1 | 249.7 | 175.8 | 209.1 | 233.3 |
| | 2004 | 233.20 | 127.3 | 233.8 | 249.7 | 232.1 | 204.8 |
| Temperature (°C) | 2003 | 12.30 | 17.4 | 23.4 | 26.4 | 27.7 | 26.9 |
| | 2004 | 10.70 | 14.5 | 23.8 | 26.9 | 28.7 | 21.6 |
| Rainfall (mm) | 2003 | 77.80 | 24.5 | 79.8 | 27.3 | 30.9 | 6.8 |
| | 2004 | 9.71 | 29.1 | 6.1 | 86.9 | 4.8 | 4.9 |
| Relative humidity (%) | 2003 | 79.00 | 69.5 | 63.5 | 69.0 | 66.0 | 69.0 |
| | 2004 | 81.70 | 75.0 | 66.0 | 69.0 | 69.0 | 68.0 |

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Table 2: Soil characteristics in research field

| Years | Sand (%) | Silt (%) | Clay (%) | Absorption potassium (ppm) | Absorption phosphor (ppm) | Total nitrogen (%) | Neutralize matters | EC | Saturation (%) | Organic carbon (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2003 | 14 | 50 | 36 | 270 | 13.7 | 0.22 | 27.5 | 2.0 | 46.8 | 2.2 |
| 2004 | 13 | 49 | 38 | 286 | 19.9 | 0.29 | 25.0 | 2.4 | 43.6 | 2.7 |

Table 3: Results of combined analysis of stem pruning and nitrogen levels on seed oil percentage and fatty acids

| Sources of variable | df | Oil | Palmitic acid | Stearic acid | Linoleic acid | Oleic acid | Length | Diameter | Width |
|---|---|---|---|---|---|---|---|---|---|
| Y | 1 | 23.437* | 0.0077ns | 0.0015ns | 0.0066ns | 0.6200ns | 3.062ns | 0.120ns | 3.533ns |
| R(Y) | 4 | 4.100ns | 0.3886ns | 0.5938ns | 6.8350ns | 5.4910ns | 0.049ns | 0.019ns | 0.440ns |
| H | 2 | 405.255** | 0.7511ns | 0.0324ns | 104.1050** | 97.6660** | 0.109ns | 0.030ns | 0.386ns |
| Y* H | 2 | 17.270* | 0.0074ns | 0.0204ns | 1.6910ns | 1.2403ns | 0.091ns | 0.007ns | 0.001ns |
| N | 3 | 100.620** | 0.6048ns | 0.1551ns | 87.3850** | 68.7570** | 39.764** | 3.297** | 12.618** |
| Y* N | 3 | 0.404ns | 0.2248ns | 0.1646ns | 3.6885ns | 4.8471ns | 0.810ns | 0.020ns | 0.007ns |
| H*N | 6 | 22.797ns | 0.4045ns | 0.3607ns | 7.766ns | 7.0112ns | 0.248ns | 0.020ns | 0.101ns |
| Y*H*N | 6 | 17.532** | 0.7905ns | 0.2639ns | 18.6840** | 19.8720** | 0.323ns | 0.063ns | 0.047ns |
| Error | 44 | 5.194 | 0.3991 | 0.2679 | 2.7697 | 2.3681 | 0.412ns | 0.013ns | 0.209 |
| | CV (%) | 5.394 | 4.3950 | 8.1410 | 3.2100 | 5.7560 | 3.769 | 6.537 | 5.198 |

ns, *and **: Represent not significant, significant in 5 and 1% probability level, respectively, Y = Year, R(Y) = Replication within year, H = Head pruning, N = Nitrogen***

nitrogen levels (0, 50, 100 and 200 kg $ha^{-1}$). For instance the seeds of pumpkin were sown at middle of second month of spring in each year.

Each plot had three rows and spacing was 140 cm between rows. Each row had 16 plants and spacing was 40 cm between plants. Nitrogen was applied as urea form. One-third of nitrogen was added during bed preparation before seed sowing and remained amount of it was added at four leaf stage and flowering period.

The fruits were harvested at 6 and 19 of Aug. in 2003 and 9, 16 and 29 of Aug. in 2004, when the fruits were reached to full maturity and the fruit skin colour become yellow-orange in all the treatments. Seeds were manually extracted and then dried by natural sun. The seed dimension was measured. The seed from each treatment were powdered. Oil was extracted from 20 g of powder by 300 mL n-hexane solvent in a sox let apparatus at 60°C. Solutions were taken from the extracted and were placed on a rotary evaporator. After removing the solvent the sample was dried in an oven at 80°C. The differences between the beaker containing and the empty beaker determine the amount of oil (Cert *et al*., 2000). Fatty acid composition of the seed oil was determined by gas chromatography (AOAC, 1997).

## RESULTS

Results of compound analysis of variance of data showed that the effect of year on seed dimension (length, diameter and width) and seed oil content was significant (Table 3). Seed dimensions and seed oil content in 2004 were greater than 2003. The mean of oil content of seeds were 41.68 and 42.84% in 2003 and 2004, respectively. Increase of seed dimensions and seed oil content in 2004 year is related to more favorable condition for plant growth and extending the fruit growth period due to higher rainfall (Table 1). Seed oil content was increased in early sowing in comparison with later sowing (Abak and Cetiner, 1997) or late harvest (Murkovich *et al*., 1999) because of plant longer growth period.

**Pruning:** Main stem pruning had significant effect on seed oil content, linoleic acid and oleic acid content (Table 3). The highest amount of oil and linoleic acid composition obtained from main stem pruning after 14 nodes formation (Table 4). Increases in oil content and linoleic acid composition in this treatment can be related to extending the time for fruit maturity and ripening, because increases the fruit number per plant after pruning causes each fruit need to more time for dry matter accumulation and maturity. This can be explained by increases in fruit number per plant from control (1.48) to pruning treatment (2.42 and 3.15 in head pruning of stem after formation of 10 and 14 nodes). These results agree with results of Murkovich *et al*. (1999). They showed that the oil content and linoleic acid composition depends on temperature during ripening of the fruits. That increases significantly if the temperature is lower or the pumpkins are harvested later. Head pruning treatments were not shown significant difference on palmitic and stearic acids content of seeds, which consistent with Youmis *et al*. (2000) finding. Finding of them showed for all of seeds cultivated in the three different localities the composition of palmitic and stearic acids remain constant.

**Nitrogen:** The effect of nitrogen levels on seed dimensions and seed oil content, linoleic and oleic acids content, were significant (Table 3).

Table 4: The effect of stem head pruning and nitrogen levels on seed oil percentage, linoleic fatty acids and seed diamonds

| Treatments | Oil (%) | Linoleic acid (%) | Oleic acid (%) | Length (mm) | Diameter (mm) | Width (mm) |
|---|---|---|---|---|---|---|
| **Head pruning** | | | | | | |
| H0 | 39.002c | 50.123c | 28.396a | 17.11a | 1.77ab | 8.88a |
| H1 | 40.875b | 51.261b | 27.320b | 17.08a | 1.82a | 8.87a |
| H2 | 46.868a | 54.192a | 24.490c | 16.98a | 1.74b | 8.66a |
| **Nitrogen levels** | | | | | | |
| N0 | 40.316b | 50.550b | 27.823a | 15.58d | 1.44d | 8.13c |
| N1 | 42.287b | 51.200b | 27.469a | 16.37c | 1.58c | 8.94b |
| N2 | 45.565a | 55.120a | 23.815b | 17.22b | 2.40a | 9.93a |
| N3 | 40.829b | 50.524b | 27.832a | 19.04a | 1.69b | 8.21c |

Dissimilar letters in each treatment indicate significant difference at 5% probability, H0, H1 and H2 represent No heading, head pruning of stem after formation of 10 and 14 nodes N0, N1 and N2 are 0, 50, 100 and 200 kg $ha^{-1}$ nitrogen

Results indicated that the length, diameter and width of seed increased as increase in nitrogen level from 0 to 100 kg $ha^{-1}$, but the highest value for seed length obtained 200 kg $ha^{-1}$. Increase in seed diameter or thickness is important in pumpkin production, because larger seeds have higher oil content (Murkovich *et al*., 1997). The highest amount of oil content and linoleic acid obtained by application 100 kg $ha^{-1}$ nitrogen fertilizer (Table 4).With similar reason as mentioned above. In study of Arroi and Omidbaigi (2004) on pumpkin the highest oil content was achieved at 75 kg $h^{-1}$ N fertilizer. The effect of nitrogen levels and pruning treatment on linoleic and amount oleic acid content were opposite, Youmis and Al-Shihry (2000) achieved similar results. Who found for all oil samples of seeds cultivated in the three different localities, whenever the composition of linoleic acid is high, The composition of oleic acid is low and vice versa. In this research, the amount of linoleic acid and oil content showed similar responses to treatments.

## DISCUSSION

Results of this investigation indicated that nitrogen fertilization and stem pruning could be effective in enhancing the seed oil content. Pumpkin usually produces one fruit after 17 node formation (Wien *et al*., 2004) which this fruit serve as strong sink for assimilate and inhibits from fruit production on further nodes (Robinson, 1993; Rylski, 1974). The removing of this strong sink by pruning encourages plants to produce more fruits on lateral branches.

Also nitrogen increases fruits growth on lateral branches. Fruits on lateral branches almost comprised as similar sinks and exist a balance in assimilate partitioning between these fruits which extend the fruits maturity period. Finally fruits have enough time for oil accumulation in seed. With increasing of seed oil content, linoleic acid increased, so it implies on positive correlation between oil content and linoleic acid.

## RECOMMENDATIONS

The stem pruning has good effect on more fruit production in pumpkin. But different pruning time has different effect on fruit formation. The effects of nitrogen nutrition on pumpkin are different. But using suitable concentration and suitable time of application have significant effect on the productivity (seed dimension, oil seed content) of pumpkin. It seems applying of 100 kg $ha^{-1}$ of nitrogen treatment is most suitable for some physico-chemical characteristics of pumpkin seed.

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