# The Effect of some Slow Release Nitrogen Fertilizers on Growth, Nutrient Status and Fruiting of "Mit Ghamr" Peach Trees

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**Abstract:** This study was conducted for comparing three slow release N fertilizers namely, urea – formaldehyde, phosphorus – coated urea and sulphur coated- urea and that fast release nitrogen namely (urea) at 500, 750 and 1000g/tree/year for vegetative growth, leaf mineral content, yield and fruit quality of "Mit Ghamr" peach tree grown in a private orchard Aga city Dakahlia Governorate, Egypt, during 2008 and 2009 seasons, were studied. Urea was added at two times at the start of spring growth and after fruit set, while slow – release N fertilizers applied once at the start of spring growth. Results showed that supplying the tree of "Mit Ghamr" peach with the three slow release N fertilizers were superior to the application of the fast one in improving shoot length, leaf area, percentage of leaf N, as well as physical and chemical characteristics of the fruits. Application of sulphur – coated urea (SCU), phosphorus- coated urea (PCU) and urea- formaldehyde in a descending order was very favorable. Generally, "Mit Ghamr" peach trees once with sulphur coated urea at 500-750g/trees/year was the best results on vegetative growth, yield nutritional status of trees and fruit quality. In addition saving nitrogen fertilization cost and reducing nitrate pollution. [Journal of American Science. 2010;6(12):195-201]. (ISSN: 1545-1003).

**Keywords:** N fertilizers; urea; formaldehyde; phosphorus; sulphur

## 1. Introduction:

Peach is one of the most important deciduous fruit trees grown in Egypt.

Nitrogen is known to be one of the most major elements for plant nutrition and development science it plays an important role in a constituent of all proteins, nucleic acids and enzymes synthesis (Nijjar, 1985).

Recently, new techniques for fertilization of fruit trees grown under sandy soil were arisen. Out of those, the application of controlled release N fertilizers they were developed mainly to reduce the number of replications per year, minimize the cost of production, improve the efficiency of N used by trees, reactions and the rapid denitrification (Nijjar, 1985, Allen, 1986, Alva, 1992, Scuderi et al, 1993 and Wang & Alua, 1996) The control and continues providing of the trees with their requirements from N can be achieved by using controlled release N fertilizers which are responsible for releasing their own N at a longer period and at the critical date of fruit development.

Previous studies showed that using slow release N fertilizers was preferable than using the fast one in improving growth and nutritional status of the trees. (Alvan & Tucker, 1996, Ahmed et al. 1997, Hammam & Assy, 2000; Wassel et al. 2000; Akl et al. 2002 and Mohamed & Sama Ebeed. 2008).

So, the aim of this investigation was to study the effect of three controlled release N fertilizers urea formaldehyde, phosphorus coated urea and sulphur coated urea compared to fast release (urea) on growth, nutritional status and fruit quality of "Mit Ghamr" peach cultivar trees grown in loamy soil, to find out the best one.

## 2. Materials and Methods:

During 2008 and 2009 seasons, 18 years old "Mit Ghamr" peach trees (Prunus persica L. Batch) grown in a private orchard, Aga city Dakahlia Governorate, Egypt. The selected and uniform in vigour trees were planted at 5×5 meters apart grown in loamy soil and irrigated via flood irrigation, trained to an open – vase system.

Analysis of the tested soil according to (Wilde et al. 1985) and the data are shown in Table (1).

**Table (1): Soil physical and chemical analysis.**

| Size of particles and their distribution | |
|---|---|
| Sand % | 34.50 |
| Silt % | 36.50 |
| Clay % | 29.00 |
| Texture | Loamy |
| pH (1: 2.5 extract) | 8.10 |
| E.C. (1: 2.5 extract) (mmhos/1cm) | 0.85 |
| O.M% | 2.30 |
| Total $Co_3$% | 1.73 |
| Avatilable macronutrients | |
| Total N % | 0.09 |
| Available P (ppm olsen). | 12.00 |
| Avaiable K (ppm) | 285.00 |

1. This experiment included the following 12 treatments as follows:
2. Application of urea (46.5% N) at 500g/tree.
3. Application of urea at 750 g/tree.
4. Application of urea 1000g/tree.
5. Application of urea formaldehyde (38.37% N) at 500 g N/tree.
6. Application of urea formaldehyde at 750 g N/tree.
7. Application of urea formaldehyde at 1000 g N/tree.
8. Application of phosphorus-coated urea (37.11% N) at 500g N /tree.
9. Application of phosphorus-coated urea at 750 g N /tree.
10. Application of phosphorus-coated urea at 1000g N /tree.
11. Application of sulphur-coated urea (41% N) at 500g N/ tree.
12. Application of sulphur-coated urea at 750g N/ tree.
13. Application of sulphur-coated urea at 1000g N/ tree.

The experiment was set in a completely randomized block design with three replicates each consisted with two trees.

The three slow release N fertilizers at the prementioned amounts were applied once at the start of spring in circular digs around each tree 50cm apart from trunk and covered with soil, while the fast release N fertilizers (urea) was added twice at spring growth start and after fruit stetting. The treated trees received the basal P and K fertilizers. Other horticultural practices were carried out as usual.

The following parameters were recorded for both seasons:

1- Vegetative growth measurements:

Shoot length (cm), and during mid-August of the two seasons, leaf samples were collected from the middle portion of the current season growth to determine leaf area (cm2) by using a leaf area meter (Model C/203 area meter. CID, INC. USA), and to determined percentage of N, P and K according to (Wilde, et al. 1985).

2-Leaf mineral content:

As follows: samples of leaves were taken, and distilled water washed and oven dried at 70oC till constant weight. Dried samples were pulverized separately and samples of 0.2 (g) each was digested with a mixture of sulphuric acid and hydrogen peroxide, to determine the following:

Total nitrogen percentage was measured by the micro-kjeldahl methods described by Pregl (1945).

Phosphorus percentage was determined calorimetrically according to Murphy & Reily (1962).

Potassium was measured according to Jakson (1973) by flame photometer.

3-Yield per tree: At harvesting time in early June in two seasons yield as Wight in (kg) and number of fruit per tree was recorded.

4-Fruit quality:

Fruit physical and chemical characteristics:

Samples of twenty fruits were taken from each replicate for measuring the following characteristics fruit weight (g), fruit volume (ml) and dimensions (cm); total soluble solids %TSS was measured in fruit juice by hand refractometer, total acidity% in fruit juice was determine as malice acid, and T.S.S./ acidity ratio were calculated. Total sugar contents were estimate according to (A.O.A.C (1985).

Statistical analysis:

The obtained data were statistically analyzed. Means were compared using the New L.S.D at 5% level, according to Snedecor and Cochran (1980).

**3. Results and Discussion:**

1. Vegetative growth:

It is clear from Table (1) that the application of the slow release N fertilizers, urea formaldehyde (UF), phosphorus – coated urea (PCU) and sulpher - coated urea (SCU) were have high positive effective and significantly improved, shoot length and leaf area of "Mit Ghamr" trees compared to application of fast release N fertilizer (Urea) in 2008 and 2009 seasons. The promotion on vegetative growth traits was associated with increasing the level of N from 500 till 1000g/tree.

Raising N levels from 750 to 1000 g/tree from either fast or slow release fertilizers failed to show any significant increase in these traits.

Moreover, the maximum shoot length and leaf area detected on the trees fertilized with SCU at any level. These results were true in both seasons.

Generally, the improving effects of slow release N fertilizer UF, PCU and SCU on vegetative growth might be attributed to their effect on regulating the release of N according to the plants needed. Also they gave the highest values of residual N in soil due to their low activity index, compared fast release (urea) which gave the lowest values of available N left in the soil (Mikkelsen et al. 1994).

In addition, the role of nitrogen in plants, which increase growth and development of all living tissue, also N considered to be an important constituent of chlorophyll, protoplasm, protein and nucleic acid, so that it resulted in an increase in cell number and cell size with an increase (Said, 1998 and El- Naggar et al. 2002). In addition, the substantially

improved the vegetative growth trails due to sulpher – coated urea may be attributed to acidification resulted from S oxidation that decreasing soil pH that enhanced the solubility of nutrients and increases the activity of micro-organisms. These effects increase the nutrients availability uptake and translocation and increase the vegetative growth (Yousry et al 1984). These results are in harmony with those obtained by Jackson & Davies (1984), Puchades et al. (1985), Koo, (1988), Alva & Tucker (1996), Hegab et al. (1999), Hamman & Assy (2000), Wassel et al. (2000).

2. Leaf mineral content:

It is evident from the data presented in Table (2) that application of N via slow release fertilizers was significantly preferable in increasing leaf N, P, K percentages than application of it via fast release.

In general, results indicated that increasing the level of UF, PCU and SCU were followed by a gradual increase in leaf N percentage. A meaningless, high level of leaf N, P, K percentages was detected by using the highest two levels of each slow release treatments. The best results of leaf N percentage observed at 1000g of SCU, while fast release (Urea) at the same level recorded the lowest value.

The intermediate value was shown at PCU and UF respectively. All the slow release N fertilizers gave the same content of P and K in the leaves. The maximum values of N, P and K were recorded in the tree fertilized with sulpher – coated urea (SCU). These results were true in 2008 and 2009 seasons.

Moreover, using SCU at 500 g/ tree significantly increased the growth and leaf N, P and K percentage compared with other slow release and fast fertilizers. This means that using sulpher coated-urea at 500g/tree was sufficient to improve vegetative growth and tree nutritional status as well as useful in saving N fertilization cost and reducing nitrate pollution. The great reduction in the loss of N and the increase in uptake due to the application of slow realese N fertilizers could explain the reason for their effect in improving the leaf content of N. The vice versa was obtained due the application of the fast fertilizers which was mainly attributed due to great leaching of N from soil via drainage water.

Similar results were obtained by Scuderi et al. (1983), Mquireiro et al. (1984), Marler et al. (1987), Balo et al (1988), Ferguson et al. (1988), Wang & Alva (1996), Hammam & Assy (2000) and Wassel et al. (2000).

3. Yield measurement:

Data in Table (3) showed that "Mit Ghamr" Peach yield component as affected by application of some slow releases fertilizers UF, PCU and SCU at level 500, 750 and 1000 g/tree and fast release (Urea). The treatments showed a significant difference among them in this connection. In general, increasing nitrogen level via either fast or slow release fertilizers resulted in increase yield components. Application of SCU was a considerable effect on increasing fruits number and yield/tree, while, UF and PCU recorded the intermediate values. Moreover "Mit Ghamr" Peach trees that fertilized with 500g/tree of sulphur – coated urea (SCU) recorded the highest values of fruits number and yield /tree compared to other slow release and urea. Therefore, it could be concluded that such treatments was sufficient to get satisfactory increased in yield with good quality and also very useful in saving N fertilization cost and reducing nitrate pollution. These findings are in harmony with those found by Koo, (1986), Koo (1988), Boman (1993), Scuderi, et al. (1993), Wassel et al. (2000) and Akl, et al. (2002).

4. Fruit physical and chemical characteristics.

Data in Table (5) obviously showed that fruit weight and volume were positively affected in response to application of slow release nitrogen fertilizers rather than using urea. The promotion in fruit weight and volume were associated with increasing the level of N applied from 500 till 1000g/tree.

The heaviest fruit were recorded on trees fertilized with 1000g/tree sulphur coated urea. Moreover, raising N levels from 750 to 1000g/tree failed to show any significantly increase in fruit weight and volume.

Also, data in Table (5) indicated that the effect of slow release N fertilizers, UF, PCU and SCU used on fruit length and diameter was almost similar to that concerning in fruit weight and volume.

It is clear from the data in Table (6) that the application of the three slow release N fertilizers increasing the total soluble solids and total sugar while reducing the total acidity compared to via urea at the same levels. The best results with regards to chemical fruit quality showing ascending order by using slow realese N fertilizers , while urea showed the lowest value. These results were true in 2008 and 2009 seasons in "Mit Ghamr" cv.

Generally, "Mit Ghamr" peach trees fertilized with sulphur coated urea at 500-750g/trees/year gave the best results on vegetative growth, yield nutritional status of trees and fruit quality. The stimulation effect of SCU on chemical quality was attributed to its action in enhancing the formation of carbohydrates and advancing ripening Nijar, (1985).

These results are in harmony with those obtained by Wiil and Hahdel 1986; Bomom (1993) Hegab et al. (1999) and Hamman & Asay (2000).

Table (2): Effect of soil application of fast and some slow – realease nitrogen fertilizers on some vegetative growth of "Mit Ghamr" peach trees in 2008 and 2009 seasons.

| N source and Level (g/tree) | Shoot length (cm) | | Leaf area($cm^2$) | |
|---|---|---|---|---|
| | 2008 | 2009 | 2008 | 2009 |
| - U at 500g. | 43.30 | 46.36 | 24.31 | 23.63 |
| - U at 750g. | 45.50 | 48.46 | 25.51 | 24.43 |
| - U at 1000g. | 46.30 | 49.56 | 25.81 | 24.63 |
| - UF at 500g. | 52.50 | 54.45 | 26.91 | 25.83 |
| - UF at 750g. | 54.70 | 56.85 | 27.21 | 26.78 |
| - UF at 1000g. | 55.20 | 57.35 | 27.33 | 26.93 |
| - PCU at 500g. | 58.43 | 61.45 | 28.43 | 27.53 |
| - PCU at 750g. | 60.03 | 63.45 | 28.73 | 27.63 |
| - PCU at 1000g. | 63.33 | 65.15 | 28.93 | 27.83 |
| - SCU at 500g. | 66.31 | 68.45 | 30.03 | 28.63 |
| - SCU at 750g. | 67.36 | 70.53 | 30.23 | 28.83 |
| - SCU at 1000g. | 68.36 | 71.00 | 30.46 | 29.23 |
| **- New L. S.D. at 5%** | **1.11** | **2.01** | **1.01** | **1.03** |

U: Urea; UF: Urea formaldehyde; PCU: Phosphorus-coated Urea ; SCU: Shlphur-coated urea.

Table (3): Effect of soil application of fast and some slow – realease nitrogen fertilizers on N, P and K percentage (dry weight basis) of "Mit Ghamr" peach trees in 2008 and 2009 seasons.

| N source and Level (g/tree) | Leaf – N (%) | | Leaf-P (%) | | Leaf-K (%) | |
|---|---|---|---|---|---|---|
| | 2008 | 2009 | 2008 | 2009 | 2008 | 2009 |
| - U at 500g. | 2.16 | 2.23 | 0.20 | 0.21 | 1.88 | 1.91 |
| - U at 750g. | 2.23 | 2.29 | 0.19 | 0.20 | 1.86 | 1.81 |
| - U at 1000g. | 2.24 | 2.32 | 0.18 | 0.19 | 1.85 | 1.73 |
| - UF at 500g. | 2.31 | 2.40 | 0.29 | 0.26 | 2.08 | 2.10 |
| - UF at 750g. | 2.38 | 2.46 | 0.29 | 0.26 | 2.09 | 2.11 |
| - UF at 1000g. | 2.39 | 2.47 | 0.30 | 0.27 | 2.09 | 2.10 |
| - PCU at 500g. | 2.47 | 2.53 | 0.31 | 0.28 | 2.08 | 2.10 |
| - PCU at 750g. | 2.54 | 2.59 | 0.31 | 0.29 | 2.08 | 2.10 |
| - PCU at 1000g. | 2.55 | 2.60 | 0.30 | 0.29 | 2.08 | 2.10 |
| - SCU at 500g. | 2.66 | 2.69 | 0.31 | 0.29 | 2.09 | 2.11 |
| - SCU at 750g. | 2.74 | 2.75 | 0.31 | 0.30 | 2.09 | 2.11 |
| - SCU at 1000g. | 2.75 | 2.77 | 0.31 | 0.30 | 2.10 | 2.12 |
| **- New L. S.D. at 5%** | **0.07** | **0.06** | **0.02** | **0.02** | **0.07** | **0.08** |

U: Urea; UF: Urea formaldehyde; PCU: Phosphorus-coated Urea ; SCU: Shlphur-coated urea.

Table (4): Effect of soil application of fast and some slow – realease nitrogen on yield and fruit number in one (kg) of "Mit Ghamr" peach trees in 2008 and 2009 seasons.

| N source and Level (g/tree) | Yield/ tree (kg.) | | Fruit number in one (kg.) | |
|---|---|---|---|---|
| | 2008 | 2009 | 2008 | 2009 |
| - U at 500g. | 25.16 | 27.33 | 13.59 | 13.31 |
| - U at 750g. | 26.11 | 29.11 | 12.03 | 11.87 |
| - U at 1000g. | 26.53 | 30.30 | 11.62 | 11.45 |
| - UF at 500g. | 27.30 | 31.66 | 11.09 | 10.74 |
| - UF at 750g. | 28.00 | 32.33 | 10.38 | 10.17 |
| - UF at 1000g. | 28.10 | 32.51 | 10.07 | 9.89 |
| - PCU at 500g. | 36.11 | 32.76 | 9.28 | 9.15 |

| | | | | |
|---|---|---|---|---|
| - PCU at 750g. | 36.11 | 33.10 | 8.83 | 8.68 |
| - PCU at 1000g. | 36.36 | 33.56 | 8.68 | 8.53 |
| - SCU at 500g. | 45.36 | 46.31 | 8.18 | 7.99 |
| - SCU at 750g. | 45.31 | 47.26 | 7.69 | 7.73 |
| - SCU at 1000g. | 46.00 | 48.31 | 7.44 | 7.35 |
| **- New L. S.D. at 5%** | **3.36** | **4.28** | | |

U: Urea; UF: Urea formaldehyde; PCU: Phosphorus-coated Urea; SCU: Shlphur-coated urea.

Table (5): Effect of soil application of fast and some slow - realease nitrogen on some physical characteristics of "Mit Ghamr" peach trees in 2008 and 2009 seasons.

| **N source and Level (g/tree)** | **Fruit weight (g)** | | **Fruit volume (mL.)** | | **Fruit length (cm)** | | **Fruit diameter (cm)** | |
|---|---|---|---|---|---|---|---|---|
| | 2008 | 2009 | 2008 | 2009 | 2008 | 2009 | 2008 | 2009 |
| - U at 500g. | 73.60 | 75.11 | 66.31 | 70.11 | 4.90 | 4.98 | 4.81 | 4.93 |
| - U at 750g. | 83.16 | 84.23 | 77.03 | 78.31 | 4.95 | 5.04 | 4.87 | 4.98 |
| - U at 1000g. | 86.03 | 87.30 | 81.11 | 81.23 | 4.99 | 5.02 | 4.90 | 5.02 |
| - UF at 500g. | 90.11 | 93.10 | 86.33 | 87.11 | 5.01 | 5.14 | 4.93 | 5.07 |
| - UF at 750g. | 96.31 | 98.30 | 90.09 | 92.13 | 5.12 | 5.20 | 4.92 | 5.11 |
| - UF at 1000g. | 99.30 | 101.14 | 93.30 | 96.14 | 5.18 | 5.26 | 5.03 | 5.16 |
| - PCU at 500g. | 107.71 | 109.30 | 101.31 | 103.30 | 5.26 | 5.33 | 5.17 | 5.22 |
| - PCU at 750g. | 113.23 | 115.26 | 106.23 | 100.10 | 5.29 | 5.41 | 5.20 | 5.27 |
| - PCU at 1000g. | 115.23 | 117.23 | 101.26 | 112.11 | 5.31 | 5.46 | 5.22 | 5.32 |
| - SCU at 500g. | 122.30 | 125.11 | 118.81 | 119.30 | 5.32 | 5.51 | 5.23 | 5.38 |
| - SCU at 750g. | 130.1 | 129.30 | 125.30 | 126.13 | 5.36 | 5.56 | 5.27 | 5.43 |
| - SCU at 1000g. | 134.33 | 136.11 | 129.11 | 131.16 | 5.36 | 5.58 | 5.24 | 5.46 |
| **-New L. S.D. at 5%** | **4.1** | **3.3** | **6.31** | **5.53** | **0.28** | **0.33** | **0.29** | **0.36** |

U: Urea; UF: Urea formaldehyde; PCU: Phosphorus-coated Urea; SCU: Shlphur-coated urea.

Table (6): Effect of soil application of fast and some slow-realease nitrogen of some chemical characteristics of "Mit Ghamr" peach trees in 2008 and 2009 seasons.

| **N source and Level (g/tree)** | **T.S.S(%)** | | **Total acidity (%)** | | **T.S.S /acidity** | | **Total sugar (%)** | |
|---|---|---|---|---|---|---|---|---|
| | 2008 | 2009 | 2008 | 2009 | 2008 | 2009 | 2008 | 2009 |
| - U at 500g. | 8.33 | 9.11 | 1.23 | 1.11 | 6.77 | 8.21 | 7.13 | 7.85 |
| - U at 750g. | 8.13 | 8.00 | 1.25 | 1.07 | 6.50 | 8.41 | 7.03 | 7.55 |
| - U at 1000g. | 7.73 | 9.00 | 1.39 | 1.15 | 5.56 | 7.83 | 6.93 | 7.45 |
| - UF at 500g. | 8.83 | 9.95 | 1.31 | 1.19 | 6.74 | 8.36 | 7.53 | 8.25 |
| - UF at 750g. | 8.84 | 9.96 | 1.32 | 1.20 | 6.68 | 8.30 | 7.54 | 8.05 |
| - UF at 1000g. | 8.83 | 9.94 | 1.33 | 1.21 | 6.64 | 8.21 | 7.54 | 7.95 |
| - PCU at 500g. | 9.33 | 10.11 | 1.23 | 1.10 | 7.59 | 9.19 | 8.33 | 8.75 |
| - PCU at 750g. | 9.23 | 10.10 | 1.26 | 1.07 | 7.33 | 9.44 | 8.33 | 8.75 |
| - PCU at 1000g. | 9.26 | 10.00 | 1.27 | 1.06 | 7.29 | 9.43 | 8.32 | 8.65 |
| - SCU at 500g. | 9.63 | 10.76 | 1.16 | 1.03 | 8.30 | 10.76 | 8.63 | 9.25 |
| - SCU at 750g. | 9.53 | 10.66 | 1.16 | 1.04 | 8.22 | 10.25 | 8.63 | 9.05 |
| - SCU at 1000g. | 9.51 | 10.65 | 1.17 | 1.04 | 8.12 | 10.65 | 8.65 | 9.06 |
| **- New L. S.D. at 5%** | **0.38** | **0.29** | **0.02** | **0.03** | **0.02** | **0.03** | **0.30** | **0.21** |

U: Urea; UF: Urea formaldehyde; PCU: Phosphorus-coated Urea; SCU: Shlphur-coated urea.

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