

## EFFECT OF ORGANIC AND INORGANIC FERTILIZERS ON ONION CROP

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### ABSTRACT

Onion plants (Giza 20 cv.) were grown in 1997-1998 and 1998-1999 seasons in Maryout Experimental Station of Desert Research Center , Alexandria Governorate to study the effect of FYM and town refuse fertilization treatments on onion plants before transplanting at rates of 10 and 20 ton/fad. for each, in addition to the control. NPK fertilizers were applied at rates of 40 N: 30 P<sub>2</sub>O<sub>5</sub>:50 K<sub>2</sub>O , 60 N: 45 P<sub>2</sub>O<sub>5</sub> :75 K<sub>2</sub>O and 80 N: 60 P<sub>2</sub>O<sub>5</sub> :100 K<sub>2</sub>O kg/fad. The combination between organic manure and NPK treatments were also studied .

Obtained results show that, organic manures or / and NPK treatments showed a significant increase in growth parameters, total yield, fresh and dry weight of bulb and bulb diameter . Chemical composition determined as N,P,K,Pb,Cd and Ni content, as well as T.S.S percentage in onion bulbs increased significantly due to treatments as compared with the control. The highest values and best quality concerning the previous characters was obtained in plants which received 20 ton/fad of town refuse in addition to 60 N, 45 P<sub>2</sub>O<sub>5</sub> and 75 K<sub>2</sub>O kg/fad.

The increase in heavy metals content in onion bulbs was within the safety limits for human consumption .

### INTRODUCTION

Onion ( *Allium cepa* L. ) is one of the foremost alliaceae vegetable plants, and one of the most important vegetable crops for export and local consumption. It has been used for flavouring, salads, sausages, soups and is also of a medical value .

Calcareous soils are usually poor in their organic matter content , in addition some elements become insoluble and unavailable to plants.

Application of organic manure increases growth characters, total yield and chemical composition of vegetables . Khalaf and Taha (1988) reported that organic manure at 20 m<sup>3</sup>/fad. were very beneficial for growth, total yield and NPK content in garlic plants under calcareous soil conditions. Singh *et al.* (1997) also found that application of FYM at 25 t/ha to onion plants increased growth parameters and marketable yield . In the same trend Soubeih (1998) observed that TSS and NPK content in tomato fruits increased with the application of 20 t/fad. town refuse.

Some studies have been reported on the positive effect of NPK on onion and garlic. Abo-Sedra *et al.* (1991) revealed that there were significant increments in growth of such plants with increasing fertilization levels of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O up to 120 : 60 : 96 kg./fad. respectively. Serrano *et al.* (1995) and Vachhni and Patel (1996) found that chemical fertilizers gave the best

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results of bulb diameter, weight and crop yield . In the same line Hassnien (1996) found that addition of NPK increased Cd and Pb concentration in cucumber, also Oukal (1999) showed that, higher NPK application (120 N+ 60 P<sub>2</sub>O<sub>5</sub> +45 K<sub>2</sub>O kg /fad. ) resulted in higher NPK content of onion bulbs.

Jana and Jahangir (1990) applied FYM at 20t/ha. combined with 100 kg N, 60 kg P and 100kg K on onion resulted in the highest values of plant height, bulb weight, bulb diameter and yield of onions, also Singh *et al.*(1997) found that OM with NPK application to onion plants increased bulb diameter, Size and marketable yield . Kropisz (1992) indicated that FYM at 25 t/ha with NPK increased NPK content of onion , Hassnien (1996) also found that addition of organic manure and NPK fertilizers increased Cd, Pb and Ni concentration in cucumbers .

The aim of this study was to evaluate the efficiency of organic manure or / and NPK fertilizers on onion plant growth, total bulb yield and its components and chemical composition under calcareous soil conditions.

## **MATERIALS AND METHODS**

Two field experiments were conducted in Desert Research Center Maryout Experimental Station, Alexandria Governorate, during the two successive seasons of 1997- 1998 and 1998- 1999, to study the effect of organic manures or / and mineral fertilizers on growth, yield and chemical composition of onion, (*Allium cepa* L.) cv. Giza 20. The soil of the experimental station is a calcareous soil with 53.59% sand, 19.83% silt, 26.58% clay, 55% calcium carbonate, 8.05 pH .

Twenty treatments , (the combination between 5 organic manure treatments and 4 NPK levels) were applied in a split plot design with four replicates. Organic manure treatments were arranged in the main plots, while the levels of NPK fertilizers were distributed randomly in the sub plots. The area of each plot was 10.5 m<sup>2</sup> including 5 rows, each row was 3.5 m long and 60 cm apart.

Organic manure included FYM and TR at rates of 10 and 20 t/fad. from each the treatments, were added to the soil before transplanting. The tested NPK fertilizer levels were : Control (NPK)<sub>0</sub> , 40 N: 30 P<sub>2</sub>O<sub>5</sub> :50 K<sub>2</sub>O kg/fad. (NPK)<sub>1</sub> , 60 N: 45 P<sub>2</sub>O<sub>5</sub> :75 K<sub>2</sub>O kg/fad. (NPK)<sub>2</sub> and 80 N: 60 P<sub>2</sub>O<sub>5</sub> :100 K<sub>2</sub>O kg/fad.(NPK)<sub>3</sub>.The used NPK source were ammonium sulphate (21.5% N), calcium superphosphate (15.5% P<sub>2</sub>O<sub>5</sub>) and potassium sulphate ( 48% K<sub>2</sub>O) . The used amount of calcium superphosphate was added to the soil one time before transplanting. While the tested ammonium and potassium sulphate doses were divided into three equal portions and applied to the soil 30, 60 and 90 days after transplanting.

Onion seeds were sown in the nursery on september 4<sup>th</sup> and 8<sup>th</sup> in the two seasons respectively. Seedlings were transplanted after 65 days from sowing . The seedlings were transplanted on both sides of ridges 10 cm apart. The normal cultural practices of onion crop growing were followed.

Samples for vegetative characters were taken 20 weeks after transplanting, and the following data were recorded : plant length, number of leaves per plant and fresh and dry weight of both plant leaves and bulb.

Data were also recorded for total yield, weight of bulb, bulb diameter and dry matter content of bulbs. Chemical composition of onion bulbs were determined as TSS (A.O.A.C.,1975), total nitrogen and heavy metals determined by methods described by Page *et al.* (1982). While phosphorus and potassium were estimated according to APHA (1989) and Brown and Lilleland (1964) respectively. Obtained data were subjected to statistical analysis according to Gomez and Gomez (1984).

**Table (A):The heavy metals content of lead, cadmium and nickle as PPM in bulbs treated with organic manures or / and NPK fertilizers were within the allowed range for human consumption, and below the toxic range as mentioned by Abd-El-Maksoud (1993)**

| Data obtained              |  | Pb (PPM) | Cd (PPM) | Ni (PPM) |
|----------------------------|--|----------|----------|----------|
| Yousf, Shadia, B.D. (2000) | The range of heavy metals in onion bulbs | 102-5.5  | 0.4-0.9  | 1.3-1.6  |
| Abd-El-Maksoud (1993)      | Toxicity limits of heavy metals in plant | 200      | 20       | 35       |

## RESULTS AND DISCUSSION

### Vegetative growth:

Data illustrated in Table (1) show the effect of organic manure on the vegetative growth characteristics of onion plants 20 weeks after transplanting, and expressed as plant length, number of leaves , fresh and dry weight of leaves and bulb per plant . Data reveal that, all studied growth characters increased significantly due to the application of different levels of organic manure during both growing seasons as compared with the control. In this respect , the highest increment in growth parameters were obtained due to the application of town refuse at 10 and 20 t/fad.

Obtained results may be due to the fact that the decomposition of organic matter decreased the pH value and consequently nutrients in the soil became more available to plant hence enhanced plant growth .

The results agree with those reported by Khalaf and Taha (1988) on garlic, Singh *et al.* (1997) on onion and Soubeih (1998) on tomato. Anid *et al.*(1983) added that TR decreased osmotic pressure of the soil solution and consequently improved the uptake of soil nutrients required by plants.

Data illustrated in Table (1) show clearly that , growth parameters of onion plants increased significantly with increasing the levels of NPK when compared with the control. The highest apperent differences in growth parameters due to NPK application were cleared in sample taken after 20 weeks from transplanting. This may be due to the fact that the biological age of onion plants affects to a great extent the favourabl response of plant growth to different NPK treatments. The addition of NPK had a good effect on



growth of plants (Abo-Sedera *et al.*, 1991 on garlic and Oukal, 1999 on onion). This may be due to the important role of N in plants. N is found in proteins, nucleic acids and co-enzymes (Devlin, 1979), phosphorus also has a role in N<sub>2</sub> fixation, enhance nodulation of plant and increase photosynthesis of plant, while potassium activates some enzymes and K<sup>+</sup> ions play an important role in targon control stomatal guard cells of leaves and as well increase photosynthesis (Abd-El- Aal,1990 and Said, 1997).

Data presented in Table (2) show the effect of OM combined with NPK fertilizers on growth characters of onion plants. The growth parameters of onion plants increased with the application of OM with NPK rates as compared with the control.

These results show a trend nearly similar to that obtained by Jana and Jahangir (1990) Serrano *et al.*(1995) and Singh *et al.* (1997) on onion. This may be due to the positive effect of OM in increasing the water holding capacity and organic matter content in the soil. Moreover it improves the physical properties of soil, OM also provides plants with the needed nutrients (Gamal, 1992).NPK application supplies plants with these nutrients and activates their growth (Devlin, 1979). The significant response of growth parameters of onion plants 20 weeks after transplanting may be due to the great release of minerals and nutrients from TR which decrease the harmful effect of calcareous soil on plant growth, (Khalil *et al.*1991).

#### **Yield and its components :**

Data concerning yield and its components, expressed as total yield, fresh and dry weight of bulb, neck and bulb diameter, are presented in Tables (3 & 4).

Data shows that organic manures application significantly increased total yield in both growing seasons. Town refuse application at rates 10 or 20 t/fad. surpassed other treatments in their effect on fresh and dry weight of bulb and bulb diameter when compared with the control. Onion plants which received TR at the rate of 20 t/fad. produced the highest total yield as compared with any of the other organic manure treatments. The obtained results agree with those of Serrano *et al.* (1995) and Singh *et al.* (1997). The positive effect of OM on onion yield may be due to the fact that the addition of FYM or TR increased organic matter content and improved the structure and the physical properties of the soil ( Gamal, 1992). OM supplies soil with nutrients which plants need and consequently improve yield ( Ekbladh 1995). The obtained results show that the addition of NPK at different used levels significantly increased total yield, fresh and dry weight of bulb as well as bulb diameter per plant when compared with the control during the two growing seasons.







The (NPK)<sub>2</sub> 60N : 45P<sub>2</sub>O<sub>5</sub> : 75K<sub>2</sub>O kg/fad. recorded the highest onion yield and its components , when compared with other NPK levels. The positive effect of NPK applications on yield and its components of onion were in the same line with those obtained by Anez *et al.*(1994) and Vachhanin and Patel (1996) . The increase of onion yield and its components with the addition of NPK may be due to the fact that application of nitrogen increases leaf cell number and size and increases leaf production and protein synthesis , which consequently increases crop production. Phosphorus also is an essential element for photosynthesis processes, respiration, nitrogen and carbohydrate metabolism. In the same line potassium is essential for plant respiration and development of photosynthesis processes and chlorophyll content and protein synthesis. The important role of NPK in improving growth and yield of plants was explained by (Devlin, 1979).

Regarding , the effect of interaction between OM and NPK fertilizers on total yield, fresh and dry weight of bulb in addition to bulb diameter . Obtained results show significant increase of onions yield and fresh weight of bulb with OM and NPK application when compared with the control. The highest value of total yield was achieved by the treatment of 20t/fad. TR plus (NPK)<sub>2</sub> 60N : 45P<sub>2</sub>O<sub>5</sub> : 75K<sub>2</sub>O kg/fad. In general OM and NPK increased onion yield and its components . These results are in line with those of Warade *et al.*(1996) and Singh *et al.* (1997) .

#### **Chemical composition**

Differences in bulb minerals content in onion in relation to organic manures treatments are shown in Tables (5 and 6) . Results indicated that OM treatments, significantly increased nitrogen, phosphorus and potassium content in bulbs at harvest (26 weeks old) , when compared with the control . The highest values of NPK were in plants which received town refuse at 20 t/fed. in both growing seasons .

The positive effect of organic manures application on NPK content in onions agree with results obtained by Khalaf and Taha (1988), Abo- El-Defan (1990) and El- Shimi (1998). The favourable effect of organic manure on NPK content may be due to its beneficial effect on soil reaction and the increased availability of nutrients to plants ( Khalil *et al.*, 1991). The application of OM to onion plants significantly increased T.S.S in onion bulbs. The increase of T.S.S in onion bulbs may be due to the effective role of OM in providing the soil with elements that improve bioprocess in plants and leads to increased T.S.S. (Soubeih, 1998). Obtained results agree with Midan (1995) who showed that OM increased pigments, Vitamin C and T.S.S. in pepper fruit. As regard organic manure application to onion plants increased lead, cadmium and nickel in onion bulbs. These results are in the same line with those obtained by Anid *et al.*(1983) and Abd el- Aty (1997). This is due to the existence of heavy metals in organic manure and their release to the soil after the analysis of the compounds of OM, the uptake of these elements from the soil solution increases their content in plants. (Khalil *et al.*, 1991).





Data in Tables (5 and 6) show the effect of different NPK rates on the chemical composition of onion bulbs under calcareous soil conditions. The application of NPK levels to onion plants induced a significant increase in the NPK content in onion bulbs, when compared with the control. The highest values were obtained with (NPK)<sub>3</sub> 80 N: 60 P<sub>2</sub>O<sub>5</sub> : 100 K<sub>2</sub>O kg/ fad. Obtained results are in harmony with those obtained by Oukal (1999). The addition of NPK to the soil increased its level in the soil solution, and consequently increased its uptake by the plants (Patel *et al* 1992). NPK fertilizers significantly increased T.S.S. in onion bulbs. The highest percentage of T.S.S. in onion bulbs was obtained with the application of (NPK)<sub>2</sub> and (NPK)<sub>3</sub>. These results agree with those mentioned by Haggag *et al* (1986). This increase may be due to the effective role of macro nutrients in activating metabolism and syntheses of proteins and carbohydrates and increasing photosynthesis processes (Devlin, 1979). As for, the effect of NPK application on heavy metals content expressed as Pb, Cd and Ni in onion bulbs results show that (NPK)<sub>2</sub> and (NPK)<sub>3</sub> gave a positive significant increase in heavy metals in onion bulbs when compared with the control in the first growing season, while, in the second season, no significant increase in heavy metals content in onion bulbs was obtained Warade *et al* (1995) and Hassnien (1996) indicated that applying NPK increased Pb, Cd and Ni content in plants.

The effect of OM combined with different rates of NPK on the chemical composition of onion bulbs are shown in Tables (7 and 8) Data shows that N and K content significantly increased in onion bulbs with applying (NPK)<sub>2</sub> and (NPK)<sub>3</sub> combined with FYM or TR at rates 10 or 20 t/fad. However the treatment of TR at 20 t/fad. plus (NPK)<sub>3</sub> gave the highest values. The positive effect of interaction between organic manure and NPK fertilizers on NPK content in bulbs agree with the results obtained by Kropisz (1992) and Midan (1995). These results may be due to the favourable effect of TR on soil reaction and hence increasing the availability of nutrients to plants (Khalil *et al* (1991).

The addition of NPK fertilizers to the soil increases their content in plants, NPK content in plants increases with increasing the level of fertilization (Abo-Sedera *et al* 1991). Respecting, the interaction between OM and different rates of NPK fertilizers to onion plants increased T.S.S in onion bulbs as shown in Table (7), but increases were not significant as compared to the control. The results agree with those obtained by Pimpini *et al* (1992). The effect of OM combined with different rates of NPK fertilizers on heavy metals content in onions expressed as Pb, Cd and Ni are illustrated in Table (8). Data shows a significant increase in heavy metals content in onions which received organic manure with NPK fertilizer treatments when compared with the control. The results agree with those obtained by Warade *et al* (1995) and Hassninen (1996). This may be due to the fact that the addition of organic manures might increase the amounts of soil heavy metals and increase their uptake in plants (Hassninen, 1997). Abd el- Aty (1997) found that the concentration of heavy metals in plants increased by increasing the application of town refuse and chemical fertilizers.



**Table (8): Effect of interaction between organic manure and NPK fertilization levels on heavy metals (ppm) after harvest in onion bulbs.**

| Characters<br>Treatments | Season              | 1997-1998 |      |      | 1998-1999 |      |      |
|--------------------------|---------------------|-----------|------|------|-----------|------|------|
|                          | Heavy metals ( ppm) |           |      |      |           |      |      |
|                          | Cd                  | Pb        | Ni   | Cd   | Pb        | Ni   |      |
|                          | NPK 0               | 0.40      | 1.20 | 1.20 | 0.40      | 1.50 | 0.80 |
|                          | NPK 1               | 0.50      | 1.30 | 1.00 | 0.40      | 2.80 | 0.90 |
| <b>Control</b>           | NPK 2               | 0.60      | 2.20 | 1.20 | 0.60      | 1.00 | 1.00 |
|                          | NPK 3               | 0.60      | 3.30 | 1.30 | 0.40      | 2.20 | 0.80 |
|                          | NPK 0               | 0.70      | 2.50 | 0.80 | 0.70      | 1.50 | 1.20 |
|                          | NPK 1               | 0.60      | 1.50 | 1.30 | 0.50      | 1.20 | 1.10 |
| <b>F.Y.M. 10</b>         | NPK 2               | 0.70      | 3.90 | 1.30 | 0.60      | 2.40 | 1.10 |
|                          | NPK 3               | 0.60      | 4.60 | 1.60 | 0.50      | 2.80 | 1.20 |
|                          | NPK 0               | 0.50      | 3.50 | 1.20 | 0.50      | 3.10 | 0.90 |
|                          | NPK 1               | 0.70      | 2.50 | 1.50 | 0.50      | 3.40 | 1.00 |
| <b>F.Y.M. 20</b>         | NPK 2               | 0.70      | 3.30 | 1.30 | 0.50      | 2.90 | 1.00 |
|                          | NPK 3               | 0.60      | 5.50 | 1.30 | 0.60      | 4.60 | 1.10 |
|                          | NPK 0               | 0.50      | 3.30 | 1.40 | 0.50      | 1.00 | 0.80 |
|                          | NPK 1               | 0.50      | 4.70 | 1.30 | 0.60      | 3.50 | 0.90 |
| <b>T.R 10</b>            | NPK 2               | 0.5       | 2.50 | 1.20 | 0.40      | 4.50 | 1.00 |
|                          | NPK 3               | 0.60      | 2.20 | 1.30 | 0.40      | 2.40 | 0.80 |
|                          | NPK 0               | 0.50      | 2.20 | 1.50 | 0.40      | 1.70 | 1.00 |
|                          | NPK 1               | 0.50      | 3.00 | 1.30 | 0.60      | 4.70 | 1.00 |
| <b>T.R. 20</b>           | NPK 2               | 0.90      | 4.00 | 1.30 | 0.50      | 3.40 | 1.10 |
|                          | NPK 3               | 0.80      | 3.10 | 1.20 | 0.50      | 1.40 | 0.80 |
| <b>L.S.D. at 0.05</b>    |                     | 1.0       | 0.3  | 0.9  | 4.8       | 2.0  | 0.2  |

However obtained results provide that the heavy metals content in onion bulbs were within the safety levels for human consumption Table (A).

Generally it may be concluded that the use of organic manure and NPK fertilizers is very important to improve yield and quality of onions under calcareous soil conditions , the use of OM decreases the needed amounts of chemical fertilizers and as well decreases cost and environmental pollution.

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تأثير الأسمدة العضوية و غير العضوية على محصول البصل  
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١ قسم الإنتاج النباتي ، مركز بحوث الصحراء  
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زرعت نباتات البصل (صنف جيزة ٢٠) خلال موسمى الزراعة ١٩٩٧-١٩٩٨ و ١٩٩٨-١٩٩٩ بمحطة تجارب بحوث مريوط التابعة لمركز بحوث الصحراء - محافظة الاسكندرية - لدراسة تأثير إضافة مخلفات المزرعة و مخلفات المدن بمعدل ١٠ ، ٢٠ طن للفدان لكل منهما قبل نقل الشتلات بالاضافة إلى معاملة المقارنة (بدون اضافات) . وقد تم إضافة الاسمدة النتروجينية و الفوسفاتية و البوتاسية بمعدلات ( ٤٠ ن : ٣٠ فو ٥٢ : ٥٠ بو ٢ أ و ٦٠ ن : ٤٥ فو ٥٢ : ٧٥ بو ٢ أ و ٨٠ ن : ٦٠ فو ٥٢ : ١٠٠ بو ٢ أ ) كجم / فدان بالاضافة لمعاملة المقارنة ، و التوافق الممكنة بين الأسمدة العضوية و المعدنية . و قد كان التصميم الاحصائى للتجربة قطاعات منشقة مرة واحدة

أظهرت النتائج المتحصل عليها أن الأسمدة العضوية أو المعدنية أو كلاهما معا أدت إلى زيادة معنوية فى قياسات النمو لنباتات البصل بالاضافة إلى المحصول الكلى و الوزن الطازج و الجاف للبصلة و قطر البصلة و قد تم تقدير التركيب الكيماوى و محتواة فى الأبصال ممثلة فى النتروجين الكلى و الفوسفور و البوتاسيوم و أيضاً تقدير الرصاص و الكاديوم و النيكل بالاضافة لنسبة المواد الصلبة الذائبة . و قد أدت المعاملات المستخدمة إلى زيادة نسب هذه المكونات الكيماوية معنويا عند مقارنتها بمعاملة المقارنة ( بدون اضافات ) . زادت معنويا بالمعاملات السابقة ذكرها عند مقارنتها بمعاملات المقارنة .

أوضحت النتائج المتحصل عليها ان معاملات الأسمدة العضوية او المعدنية او كلاهما قد ادت الى زيادة معنوية فى صفات النمو ، المحصول الكلى ، الوزن الطازج و الجاف للبصل و قطر البصلة لنباتات البصل . و ايضا تم تقدير المكونات الكيماوية ( نيتروجين و الفوسفور و البوتاسيوم و الكالسيوم و النيكل ) كما تم تقدير نسبه المواد الصلبة الذائبة الكليه فى الأبصال .

و قد تم الحصول على أفضل النتائج و أحسن جودة بالنسبة للصفات السابق ذكرها فى النباتات التي عوملت بمخلفات المدن بمعدل ٢٠ طن للفدان مع المعدل الثانى من التسميد المعدنى ( ٦٠ ن : ٤٥ فو ٥٢ : ٧٥ بو ٢ أ كجم / فدان ) .

و قد كانت الزيادة فى المعادن الثقيلة فى محصول الأبصال آمنة وليست ضارة بالصحة حيث أنها فى الحدود المسموح بها و بعيدة عن حدود السمية فى النبات . و لذلك ينصح بالجوء لإستخدام الأسمدة العضوية مع الأسمدة المعدنية لتحقيق أفضل النتائج لتقليل كميات الاسمدة الكيماوية المستخدمة لتقليل التكاليف و التلوث الناتج عن الإفراط فى استخدام الأسمدة الكيماوية .

Table (1) : Effect of organic manure or NPK fertilization levels on bulbing characteristics of onion plants (20 weeks after transplanting ) .

| Season<br>Character<br>Treatment | 1997-1998    |                  |                     |                     |                 |                 | 1998-1999    |                  |                     |                     |                 |                 |
|----------------------------------|--------------|------------------|---------------------|---------------------|-----------------|-----------------|--------------|------------------|---------------------|---------------------|-----------------|-----------------|
|                                  | P.L.<br>(cm) | L. No.<br>/Plant | L.F.W.<br>(g)/Plant | L.D.W.<br>(g)/Plant | Bulb<br>F.W.(g) | Bulb<br>D.W.(g) | P.L.<br>(cm) | L. No.<br>/Plant | L.F.W.<br>(g)/Plant | L.D.W.<br>(g)/Plant | Bulb<br>F.W.(g) | Bulb<br>D.W.(g) |
| <b>Effect of OM (ton/fed.)</b>   |              |                  |                     |                     |                 |                 |              |                  |                     |                     |                 |                 |
| Control                          | 70.5         | 7.2              | 73.9                | 9.0                 | 63.3            | 6.6             | 60.9         | 6.4              | 49.4                | 4.0                 | 64.7            | 7.9             |
| FYM (10)                         | 77.9         | 7.6              | 84.7                | 11.1                | 68.3            | 9.5             | 67.1         | 6.9              | 64.0                | 5.0                 | 72.0            | 10.5            |
| FYM (20)                         | 79.9         | 7.3              | 98.3                | 11.3                | 67.0            | 9.7             | 65.7         | 6.8              | 58.0                | 5.2                 | 73.2            | 9.6             |
| TR (10)                          | 80.9         | 7.8              | 101.1               | 11.1                | 74.1            | 9.6             | 70.6         | 7.1              | 80.9                | 6.7                 | 76.5            | 10.7            |
| TR (20)                          | 82.5         | 8.4              | 109.9               | 12.6                | 82.6            | 10.7            | 70.5         | 7.4              | 75.5                | 5.8                 | 90.1            | 13.0            |
| <b>L.S.D. at 0.05</b>            | 1.0          | 0.7              | 16.0                | 1.9                 | 12.1            | 2.0             | 2.8          | 0.6              | 11.7                | 1.4                 | 13.1            | 2.2             |
| <b>Effect of NPK (kg/fed.)</b>   |              |                  |                     |                     |                 |                 |              |                  |                     |                     |                 |                 |
| (NPK) <sub>0</sub>               | 72.0         | 6.6              | 81.2                | 9.3                 | 63.9            | 7.6             | 65.0         | 6.4              | 57.3                | 4.2                 | 64.7            | 7.9             |
| (NPK) <sub>1</sub>               | 76.8         | 7.3              | 92.2                | 10.9                | 68.9            | 8.9             | 66.0         | 7.0              | 64.8                | 5.4                 | 72.0            | 10.5            |
| (NPK) <sub>2</sub>               | 82.2         | 8.2              | 102.3               | 12.3                | 77.1            | 9.8             | 69.5         | 7.2              | 69.2                | 6.1                 | 73.2            | 9.6             |
| (NPK) <sub>3</sub>               | 82.0         | 8.6              | 98.6                | 11.6                | 74.3            | 10.5            | 67.3         | 7.1              | 71.0                | 5.7                 | 76.5            | 10.7            |
| <b>L.S.D. at 0.05</b>            | 1.2          | 0.5              | 10.6                | 1.1                 | 8.8             | 1.1             | 2.9          | 0.4              | 7.4                 | 0.7                 | 13.1            | 2.2             |

**Table (2) : Effect of interaction between organic manure and NPK fertilization levels on vegetative growth characteristics of onion plants[20 weeks after transplanting]**

| Season Characters Treatments |       | 1997-1998 |          |          |          |           |           | 1998-1999 |          |          |          |           |           |
|------------------------------|-------|-----------|----------|----------|----------|-----------|-----------|-----------|----------|----------|----------|-----------|-----------|
|                              |       | P.L. (cm) | L.No. /P | L.F.W(g) | L.D.W(g) | B.F.W (g) | B.D.W (g) | P.L. (cm) | L.No. /P | L.F.W(g) | L.D.W(g) | B.F.W (g) | B.D.W (g) |
| Control                      | NPK 0 | 65.1      | 5.9      | 60.1     | 5.9      | 3.5       | 0.4       | 60.5      | 5.6      | 42.2     | 3.4      | 3.1       | 0.4       |
|                              | NPK 1 | 68.1      | 7.1      | 73.4     | 8.6      | 3.3       | 0.4       | 62.3      | 6.5      | 52.6     | 3.1      | 3.4       | 0.4       |
|                              | NPK 2 | 75.5      | 7.9      | 79.9     | 10.3     | 3.5       | 0.5       | 62.8      | 6.6      | 46.5     | 4.4      | 3.3       | 0.3       |
|                              | NPK 3 | 76.6      | 8.1      | 82.4     | 11.0     | 4.0       | 0.5       | 64.4      | 6.8      | 56.3     | 5.1      | 3.5       | 0.4       |
| F.Y.M. 10                    | NPK 0 | 71.3      | 6.5      | 73.9     | 8.5      | 4.3       | 0.6       | 65.7      | 6.4      | 55.9     | 4.5      | 3.0       | 0.4       |
|                              | NPK 1 | 75.5      | 7.0      | 84.1     | 11.2     | 3.5       | 0.6       | 64.2      | 6.8      | 64.3     | 5.7      | 3.6       | 0.5       |
|                              | NPK 2 | 83.6      | 8.4      | 95.5     | 12.8     | 4.4       | 0.5       | 70.4      | 6.9      | 67.4     | 5.2      | 3.4       | 0.4       |
|                              | NPK 3 | 81.1      | 8.4      | 85.4     | 12.0     | 4.5       | 0.5       | 68.2      | 7.4      | 68.5     | 4.6      | 3.2       | 0.4       |
| F.Y.M. 20                    | NPK 0 | 71.0      | 6.6      | 78.8     | 9.4      | 3.7       | 0.5       | 63.1      | 6.6      | 49.2     | 3.4      | 3.5       | 0.5       |
|                              | NPK 1 | 83.1      | 7.1      | 100.6    | 11.4     | 3.9       | 0.6       | 67.9      | 7.0      | 59.6     | 6.0      | 3.9       | 0.5       |
|                              | NPK 2 | 83.4      | 7.6      | 104.4    | 12.7     | 3.9       | 0.5       | 67.7      | 7.1      | 61.6     | 6.4      | 4.4       | 0.4       |
|                              | NPK 3 | 81.9      | 8.0      | 109.5    | 11.7     | 4.2       | 0.5       | 64.2      | 6.6      | 61.3     | 5.1      | 4.5       | 0.5       |
| T.R 10                       | NPK 0 | 76.8      | 6.5      | 87.8     | 10.0     | 3.3       | 0.5       | 67.1      | 6.5      | 67.1     | 4.8      | 3.9       | 0.5       |
|                              | NPK 1 | 78.0      | 7.4      | 95.5     | 11.0     | 3.6       | 0.5       | 70.6      | 6.9      | 74.6     | 7.2      | 4.0       | 0.5       |
|                              | NPK 2 | 84.0      | 8.6      | 114.5    | 12.1     | 5.0       | 0.5       | 75.6      | 7.6      | 90.8     | 7.6      | 5.1       | 0.6       |
|                              | NPK 3 | 85.0      | 8.8      | 106.4    | 11.1     | 5.5       | 0.8       | 69.2      | 7.4      | 91.2     | 7.2      | 4.2       | 0.6       |
| T.R. 20                      | NPK 0 | 80.1      | 7.5      | 105.3    | 12.6     | 3.9       | 0.5       | 68.5      | 6.8      | 72.2     | 4.9      | 3.9       | 0.5       |
|                              | NPK 1 | 80.3      | 7.9      | 107.6    | 12.1     | 4.3       | 0.5       | 69.1      | 7.7      | 73.0     | 4.9      | 4.6       | 0.6       |
|                              | NPK 2 | 84.3      | 8.5      | 117.4    | 13.5     | 4.4       | 0.6       | 74.2      | 7.7      | 79.4     | 6.9      | 4.0       | 0.5       |
|                              | NPK 3 | 85.3      | 9.5      | 109.4    | 12.2     | 4.0       | 0.5       | 70.3      | 7.5      | 77.4     | 6.5      | 3.7       | 0.5       |
| L.S.D. at 0.05               |       | 2.7       | N.S      | N.S      | N.S      | N.S       | N.S       | N.S       | N.S      | N.S      | N.S      | N.S       | N.S       |

Table (3):Effect of organic manure or NPK fertilization levels on bulbing characteristics and total yield of onion plants [ at harvest ].

| Season<br>Characters<br>Treatments.       | 1997-1998                    |                              |                  |                  |                             | 1998-1999                    |                              |                  |                  |                             |
|---|------------------------------|------------------------------|------------------|------------------|-----------------------------|------------------------------|------------------------------|------------------|------------------|-----------------------------|
|   | F.W. of<br>bulb/<br>plant(g) | D.W. of<br>Bulb/<br>Plant(g) | Neck<br>diameter | Bulb<br>diameter | Total<br>yield<br>(ton/fed) | F.W. of<br>bulb/<br>plant(g) | D.W. of<br>bulb/<br>plant(g) | neck<br>diameter | bulb<br>diameter | Total<br>yield<br>(ton/fed) |
| <b>Effect of Organic manure (ton/fed)</b> |                              |                              |                  |                  |                             |                              |                              |                  |                  |                             |
| <b>Control</b>                            | 115.7                        | 16.7                         | 0.8              | 6.3              | 8.080                       | 148.5                        | 19.2                         | 0.9              | 6.9              | 9.200                       |
| <b>FYM<sub>10</sub> (ton/ fad)</b>        | 128.1                        | 17.3                         | 0.8              | 6.7              | 10.000                      | 145.1                        | 21.0                         | 0.9              | 7.0              | 10.320                      |
| <b>FYM<sub>20</sub> (ton/ fad)</b>        | 138.5                        | 19.0                         | 0.8              | 6.8              | 11.440                      | 146.7                        | 21.9                         | 0.8              | 7.1              | 10.400                      |
| <b>TR<sub>10</sub> (ton/ fad)</b>         | 153.3                        | 19.5                         | 0.9              | 7.3              | 10.400                      | 159.9                        | 22.9                         | 0.8              | 7.4              | 10.080                      |
| <b>TR<sub>20</sub> (ton/ fad)</b>         | 150.5                        | 20.3                         | 0.8              | 7.1              | 12.400                      | 162.0                        | 25.5                         | 0.9              | 7.8              | 11.520                      |
| <b>L.S.D at 0.05</b>                      | 21.3                         | 2.4                          | N.S              | 0.5              | 1.7                         | 21.0                         | 2.8                          | N.S              | 0.6              | 1.1                         |
| <b>Effect of NPK (Kg/fad)</b>             |                              |                              |                  |                  |                             |                              |                              |                  |                  |                             |
| <b>NPK (0 : 0 : 0)</b>                    | 111.7                        | 13.2                         | 0.8              | 6.1              | 9.040                       | 133.1                        | 18.5                         | 0.8              | 6.9              | 9.120                       |
| <b>NPK<sub>1</sub>(40:30:50kg/fad)</b>    | 134.8                        | 18.6                         | 0.8              | 6.8              | 10.240                      | 159.5                        | 22.5                         | 0.8              | 7.2              | 10.160                      |
| <b>NPK<sub>2</sub>(60:45:75kg/fad)</b>    | 150.8                        | 20.7                         | 0.8              | 7.2              | 11.280                      | 152.1                        | 23.7                         | 0.9              | 7.4              | 10.960                      |
| <b>NPK<sub>3</sub>(80:60:100kg/fad)</b>   | 149.5                        | 21.7                         | 0.9              | 7.3              | 11.280                      | 165.0                        | 23.6                         | 0.9              | 7.3              | 10.960                      |
| <b>L.S.D at 0.05</b>                      | 14.7                         | 2.3                          | N.S              | 0.4              | 0.9                         | 13.9                         | 2.3                          | N.S              | 0.3              | 0.8                         |

**Table (4): Effect of interaction between organic manure and NPK fertilization levels on bulbing characteristics and total yield of onion plants[at harvest].**

| Season                | Character Treatments | 1997-1998   |             |             |             |       | 1998-1999   |             |             |             |       |
|-----------------------|----------------------|-------------|-------------|-------------|-------------|-------|-------------|-------------|-------------|-------------|-------|
|                       |                      | b.F.W (g)/P | b.D.W (g)/P | Neck diame. | Bulb diame. | T.Y   | b.F.W (g)/P | b.D.W (g)/P | Neck diame. | Bulb diame. | T.Y   |
| <b>Control</b>        | NPK 0                | 73.3        | 7.7         | 4.7         | 0.7         | 5.520 | 113.6       | 13.5        | 6.3         | 0.8         | 6.960 |
|                       | NPK 1                | 92.0        | 13.8        | 6.1         | 0.6         | 7.600 | 134.7       | 17.8        | 7.0         | 0.8         | 9.360 |
|                       | NPK 2                | 139.5       | 20.8        | 7.0         | 0.9         | 8.480 | 148.7       | 21.8        | 6.9         | 1.0         | 9.760 |
|                       | NPK 3                | 158.0       | 24.4        | 7.3         | 0.9         | 10.72 | 197.0       | 23.5        | 7.2         | 1.0         | 10.88 |
| <b>F.Y.M. 10</b>      | NPK 0                | 100.5       | 13.3        | 6.2         | 0.8         | 8.320 | 119.3       | 16.2        | 6.7         | 0.9         | 9.280 |
|                       | NPK 1                | 124.4       | 17.4        | 6.6         | 0.8         | 8.320 | 154.6       | 19.4        | 7.1         | 0.9         | 9.760 |
|                       | NPK 2                | 136.6       | 19.3        | 7.0         | 0.8         | 9.920 | 139.0       | 23.5        | 7.0         | 0.9         | 11.20 |
|                       | NPK 3                | 150.8       | 19.2        | 6.9         | 0.9         | 10.96 | 167.6       | 24.9        | 7.2         | 0.8         | 11.04 |
| <b>F.Y.M. 20</b>      | NPK 0                | 109.6       | 14.9        | 6.2         | 0.8         | 10.16 | 137.0       | 17.7        | 6.9         | 0.8         | 9.520 |
|                       | NPK 1                | 150.3       | 21.1        | 6.8         | 0.8         | 11.84 | 180.0       | 24.7        | 6.6         | 0.9         | 10.72 |
|                       | NPK 2                | 148.4       | 18.7        | 7.0         | 0.8         | 12.08 | 130.0       | 23.2        | 7.6         | 0.8         | 10.88 |
|                       | NPK 3                | 145.8       | 21.4        | 7.2         | 0.9         | 11.60 | 138.7       | 21.8        | 7.3         | 0.8         | 10.80 |
| <b>T.R 10</b>         | NPK 0                | 149.5       | 13.4        | 7.0         | 0.8         | 9.200 | 148.5       | 20.3        | 7.0         | 0.8         | 9.28  |
|                       | NPK 1                | 149.9       | 19.9        | 7.3         | 1.0         | 9.600 | 157.7       | 23.6        | 7.5         | 0.7         | 9.360 |
|                       | NPK 2                | 171.5       | 23.1        | 7.5         | 0.9         | 11.76 | 174.5       | 24.8        | 7.7         | 0.9         | 11.20 |
|                       | NPK 3                | 142.3       | 21.6        | 7.4         | 0.9         | 12.48 | 158.7       | 22.7        | 7.2         | 0.8         | 10.64 |
| <b>T.R. 20</b>        | NPK 0                | 135.8       | 16.7        | 6.5         | 0.7         | 11.92 | 146.9       | 24.8        | 7.5         | 0.7         | 10.48 |
|                       | NPK 1                | 157.5       | 20.9        | 7.0         | 0.9         | 12.00 | 170.2       | 26.8        | 7.9         | 0.9         | 11.92 |
|                       | NPK 2                | 158.2       | 21.6        | 7.5         | 0.8         | 13.20 | 167.5       | 25.1        | 7.9         | 1.0         | 11.76 |
|                       | NPK 3                | 150.7       | 22.1        | 7.5         | 0.8         | 12.56 | 163.1       | 25.2        | 7.9         | 1.0         | 11.76 |
| <b>L.S.D. at 0.05</b> |                      | <b>N.S</b>  | N.S         | N.S         | N.S         | 2.1   | 31.2        | N.S         | N.S         | N.S         | N.S   |

b .F.W./P = Bulb fresh weight /plant (g.)

Neck diame. = Neck diameter

T.Y = Total yield ( ton /fad).

b.D.W./P = Bulb dry weight /plant (g.)

Bulb diame. = Bulb diameter

Table (5): Effect of organic manure or NPK fertilization levels on NPK Mineral content and T.S.S of onion.

| Season<br>Character<br>Treatment          | 1997-1998       |      |      |        | 1997-1998 |      |      |        |
|---|-----------------|------|------|--------|-----------|------|------|--------|
|   | Mineral content |      |      |        |           |      |      |        |
|   | N%              | P%   | K%   | T.S.S% | N%        | P%   | K%   | T.S.S% |
| <b>Effect of Organic manure (ton/fad)</b> |                 |      |      |        |           |      |      |        |
| Control                                   | 1.19            | 0.18 | 2.64 | 13.35  | 1.22      | 0.18 | 2.58 | 16.49  |
| FYM <sub>10</sub> (ton/ fad)              | 1.34            | 0.24 | 2.75 | 14.10  | 1.27      | 0.23 | 2.65 | 16.90  |
| FYM <sub>20</sub> (ton/ fad)              | 1.38            | 0.35 | 3.08 | 15.29  | 1.35      | 0.34 | 2.95 | 16.29  |
| TR <sub>10</sub> (ton/ fad)               | 1.52            | 0.37 | 2.93 | 14.19  | 1.43      | 0.34 | 2.9  | 17.69  |
| TR <sub>20</sub> (ton/ fad)               | 1.64            | 0.48 | 3.21 | 15.55  | 1.55      | 0.45 | 3.10 | 17.87  |
| L.S.D at 0.05                             | 0.06            | 0.02 | 0.12 | 0.82   | 0.11      | 0.03 | 0.07 | 1.28   |
| <b>Effect of NPK (Kg/fad)</b>             |                 |      |      |        |           |      |      |        |
| NPK (0 : 0 : 0)                           | 1.17            | 0.24 | 2.70 | 13.25  | 1.15      | 0.22 | 2.63 | 15.99  |
| NPK <sub>1</sub> (40:30:50kg/fad)         | 1.33            | 0.26 | 2.80 | 14.00  | 1.25      | 0.25 | 2.76 | 16.91  |
| NPK <sub>2</sub> (60:45:75kg/fad)         | 1.45            | 0.34 | 2.96 | 15.20  | 1.39      | 0.33 | 2.89 | 17.73  |
| NPK <sub>3</sub> (80:60:100kg/fad)        | 1.71            | 0.45 | 3.22 | 15.52  | 1.65      | 0.43 | 3.05 | 17.55  |
| L.S.D at 0.05                             | 0.07            | 0.26 | 0.07 | 0.63   | 0.053     | 0.02 | 0.06 | 0.72   |

**Table (6): Effect of organic manure or NPK fertilization levels on the heavy metals of bulb onion**

| Season<br>Character<br>Treatment          | 1997-1998       |        |        | 1997-1998 |        |        |
|---|-----------------|--------|--------|-----------|--------|--------|
|   | Mineral content |        |        |           |        |        |
|   | Cd ppm          | Pb ppm | Ni ppm | Cd ppm    | Pb ppm | Ni ppm |
| <b>Effect of Organic manure (ton/fed)</b> |                 |        |        |           |        |        |
| <b>Control</b>                            | 0.68            | 2.00   | 1.25   | 0.53      | 1.98   | 1.00   |
| <b>FYM<sub>10</sub></b> (ton/ fad)        | 0.65            | 3.13   | 3.13   | 0.58      | 1.88   | 1.15   |
| <b>FYM<sub>20</sub></b> (ton/ fad)        | 0.63            | 3.70   | 1.33   | 0.45      | 3.50   | 1.20   |
| <b>TR<sub>10</sub></b> (ton/ fad)         | 0.53            | 3.18   | 1.30   | 0.48      | 2.85   | 0.88   |
| <b>TR<sub>20</sub></b> (ton/ fad)         | 0.53            | 3.08   | 1.33   | 0.50      | 2.80   | 0.98   |
| <b>L.S.D at 0.05</b>                      | 0.07            | 0.16   | 0.08   | 0.02      | 1.18   | 0.13   |
| <b>Effect of NPK (Kg/fad)</b>             |                 |        |        |           |        |        |
| <b>NPK</b> (0 : 0 : 0)                    | 0.52            | 2.54   | 1.22   | 0.50      | 1.76   | 1.02   |
| <b>NPK<sub>1</sub></b> (40:30:50kg/fad)   | 0.56            | 2.60   | 1.28   | 0.52      | 3.12   | 1.04   |
| <b>NPK<sub>2</sub></b> (60:45:75kg/fad)   | 0.68            | 3.18   | 1.26   | 0.52      | 2.84   | 1.14   |
| <b>NPK<sub>3</sub></b> (80:60:100kg/fad)  | 0.64            | 3.74   | 1.34   | 0.48      | 2.68   | 0.96   |
| <b>L.S.D at 0.05</b>                      | 0.04            | 0.13   | 0.04   | 0.02      | N.S    | 0.07   |

Table (7): Effect of interaction between organic manure and NPK fertilization levels on Mineral content (NPK) and T.S.S in onion bulbs [at harvest].

| Seasons<br>Treatments |       | 1997-1998       |      |      |       | 1998-1999 |      |      |       |
|-----------------------|-------|-----------------|------|------|-------|-----------|------|------|-------|
|                       |       | Mineral content |      |      |       |           |      |      |       |
|                       |       | N               | P    | K    | T.S.S | N         | P    | K    | T.S.S |
| <b>Control</b>        | NPK 0 | 0.85            | 0.10 | 2.42 | 11.75 | 0.87      | 0.08 | 0.87 | 14.29 |
|                       | NPK 1 | 0.98            | 0.12 | 2.48 | 13.00 | 1.06      | 0.12 | 1.06 | 17.40 |
|                       | NPK 2 | 1.33            | 0.21 | 2.69 | 14.13 | 1.27      | 0.20 | 1.27 | 17.38 |
|                       | NPK 3 | 1.61            | 0.30 | 2.95 | 14.50 | 1.67      | 0.30 | 1.67 | 16.88 |
| <b>F.Y.M. 10</b>      | NPK 0 | 1.07            | 0.16 | 2.57 | 12.88 | 1.08      | 0.15 | 1.08 | 15.20 |
|                       | NPK 1 | 1.29            | 0.18 | 2.62 | 14.88 | 1.21      | 0.18 | 1.21 | 17.00 |
|                       | NPK 2 | 1.38            | 0.27 | 2.75 | 16.25 | 1.35      | 0.27 | 1.35 | 18.00 |
|                       | NPK 3 | 1.61            | 0.36 | 3.06 | 16.13 | 1.43      | 0.33 | 1.43 | 17.38 |
| <b>F.Y.M. 20</b>      | NPK 0 | 1.15            | 0.28 | 2.86 | 13.25 | 1.12      | 0.26 | 1.12 | 15.63 |
|                       | NPK 1 | 1.31            | 0.28 | 3.03 | 14.00 | 1.22      | 0.28 | 1.22 | 16.00 |
|                       | NPK 2 | 1.38            | 0.33 | 3.16 | 14.13 | 1.36      | 0.35 | 1.36 | 16.38 |
|                       | NPK 3 | 1.68            | 0.49 | 3.22 | 15.38 | 1.70      | 0.45 | 1.70 | 17.13 |
| <b>T.R 10</b>         | NPK 0 | 1.39            | 0.26 | 2.73 | 14.50 | 1.35      | 0.23 | 1.35 | 17.50 |
|                       | NPK 1 | 1.49            | 0.32 | 2.87 | 15.00 | 1.35      | 0.29 | 1.35 | 17.00 |
|                       | NPK 2 | 1.53            | 0.39 | 2.98 | 16.38 | 1.43      | 0.37 | 1.43 | 18.00 |
|                       | NPK 3 | 1.67            | 0.51 | 3.14 | 16.33 | 1.58      | 0.48 | 1.58 | 18.25 |
| <b>T.R. 20</b>        | NPK 0 | 1.40            | 0.40 | 2.93 | 13.25 | 1.34      | 0.38 | 1.34 | 17.33 |
|                       | NPK 1 | 1.56            | 0.42 | 2.95 | 14.00 | 1.43      | 0.38 | 1.43 | 17.13 |
|                       | NPK 2 | 1.62            | 0.50 | 3.22 | 15.20 | 1.53      | 0.47 | 1.53 | 18.88 |
|                       | NPK 3 | 1.97            | 0.61 | 3.75 | 15.52 | 1.89      | 0.58 | 1.89 | 18.13 |
| <b>L.S.D. at 0.05</b> |       | 0.23            | N.S  | 0.09 | N.S   | 0.41      | N.S  | 0.12 | N.S   |

