EFFECT OF DIFFERENT LEVELS OF INORGANIC FERTILIZERS AND COMPOST AS BASAL APPLICATION ON THE GROWTH AND YIELD OF ONION (*Allium cepa* L.)

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ABSTRACT

An experiment was carried out to find suitable ratio of inorganic fertilizer and compost, which could give an economic yield of onion (cv. Jaffna Local). This experiment was designed in a Randomized Complete Block Design with four replicates. Treatments were recommended dosage of inorganic fertilizers as a control (T_1), ¾ fold of the control treatment + compost (2 t ha^{-1}) (T_2), ½ fold of the control treatment + compost (4 t ha^{-1}) (T_3), ¼ fold of the control treatment + compost (6 t ha^{-1}) (T_4) and the compost alone (8 t ha^{-1}) (T_5). These were applied as basal application of fertilizer in this experiment. The results of this study revealed that there were significant ($P<0.05$) differences in the numbers of leaves and roots between the different treatments during the early stage of growth. Relatively higher yield (5.03 t ha^{-1}) was obtained from the plants treated with inorganic fertilizers alone (T_1), whereas compost alone (T_5) produced the lowest yield (3.43 t ha^{-1}). It was also noted that there were no significant ($P>0.05$) differences in the yields between T_1 and T_2 as well as T_1 and T_3. The inorganic fertilizers appear to have compensated with slow release of nutrients from the compost and their combined effects would have increased the yield. From this study, it could be stated that half fold of the inorganic fertilizer and compost at the rate of 4 t ha^{-1} (T_3) could give profitable yield (4.75 t ha^{-1}) and this combination could possibly reduce the cost of production in the cultivation of onion.

Key words: *compost, inorganic fertilizer, onion, yield*

INTRODUCTION

Onion (*Allium cepa* L.) is an important condiment in Sri Lanka and it has taken part in most of the Sri Lankan curry dishes. It is rich in vitamins and minerals and has several medicinal values as well. Onion is also classified as high valued cash crop because of high cost of production probably next to chilli. As such onion prices are very high presently; this cannot be affordable by the consumers. Growers also face severe problems in marketing and sometimes they do not gain better profits from onion cultivation. Farmers spend greater portion of their capital for purchasing fertilizers. Generally excessive amounts of inorganic fertilizers are applied to vegetables in order to achieve a higher yield (Stewart *et al*., 2005). However, chemical fertilizers alone generate several deleterious effects to the environment and human health and they should be replenished in every cultivation season because, the synthetic N, P and K fertilizer is rapidly lost by either evaporation or by leaching in drainage water and it causes dangerous environmental pollution (Aisha *et al*., 2007).

Continuous usage of inorganic fertilizer affects soil structure. Hence, organic manures can serve as alternative to mineral fertilizers as reported by Naeem *et al*. (2006) for improving soil structure (Dauda

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et al., 2008) and microbial biomass (Suresh *et al*., 2004). Akoun (2004) confirmed that organic manure increases the nutrient status of a soil which leads to increase in onion yield.

Generally N, P and K uptakes were significantly higher in both organically and inorganically fertilized plants than their unfertilized counterparts (Babajide *et al*., 2008). The role of nutrients is one of paramount importance in booting productivity and quality of onion which is a heavy feeder of mineral elements and continuous use of inorganic fertilizers resulted in deficiency of micronutrients, imbalance in soil physicochemical properties and unsustainable crop production (Jeyathilake *et al*., 2006). As a result, farmers are currently changing from conventional to organic farming systems which used no synthetic fertilizers and pesticides (Colla *et al*., 2002). It is due to the continuous increase of prices of synthetic chemicals in the world market.

Organic farming provides several benefits to the growers. It reduces production cost and it is an environmentally friendly method of cultivation. Addition of organic fertilizers improves soil structure and enhances activities of useful soil organisms. Agricultural commodities resulted from organic cultivation are good for human health.

Anyhow organic manures alone are unable to give economic yield and it is vital to find appropriate combinations of inorganic and organic manure to obtain financially viable yield of crops. Jeyathilake *et al*. (2006) reported that integrated use of biofertilizer, organic manure and chemical fertilizers resulted in onion yield increase in comparison with the exclusive application of chemical fertilizers. Hence, this experiment was carried out with the objectives of assessing the effects of addition of different levels of compost and inorganic fertilizer on the onion yield and finding out suitable ratio/s of compost and inorganic fertilizer which could give an economic yield of onion.

MATERIALS AND METHODS

Location

The experiment was carried out in two seasons (*maha* and *yala*) at the Agronomy farm of the Eastern University of Sri Lanka. The site was located at an elevation of 100 m above mean sea level. It belongs to the agro-ecological region of low country dry zone in Sri Lanka. The type of soil is sandy regosol. The annual mean rainfall of the district ranges from 1600 mm to 2100 mm. The average temperature varies from 28 ^{o}C to 32 ^{o}C and the humidity ranges from 65% to 86%.

Treatments and experimental design

There were five treatments in the experiment and each treatment was replicated four times. Treatments were defined according to the different levels of inorganic fertilizer and compost as basal application.

The treatments were as follows:

T_1 -Recommended dosage of Inorganic Fertilizers (IF) as a control [Urea (100 kg ha^{-1}), Triple Super Phosphate (100 kg ha^{-1}) and Muriate of Potash (50 kg ha^{-1}) (Anon. 2005)]

T_2 - ¾ fold of recommended dosage of IF + Compost at the rate of 2 t ha^{-1} (¼ fold)

T_3 - ½ fold of recommended dosage of IF + Compost at the rate of 4 t ha^{-1} (½ fold)

T_4 - ¼ fold of recommended dosage of IF + Compost at the rate of 6 t ha^{-1} (¾ fold)

T_5 - Compost at the rate of 8 t ha^{-1}

These treatments were arranged in a Randomized Complete Block Design (RCBD). The plot size was 3 m × 1 m.

Agronomic practices

Basal fertilizer according to the treatment was thoroughly incorporated with the soil one week before sowing. Onion bulbs (*cv*. Jaffna Local) obtained from the Department of Agriculture, Vavuniya. The onion bulbs were treated with captan (1g L^{-1}) before dibbling in the beds. The bulbs were sown 10 cm × 10 cm apart. The crop was raised according to the Department of Agriculture recommendations (Anon. 2005) except basal application. Weeding was done manually at 10 day intervals. Watering was done daily in the early morning for first two weeks and then applied in alternate days two weeks after sowing. Severe pest attacks and disease infestations were not observed during the experimental period. Top dressing was done at 3rd (Urea 100 kg ha^{-1}) and 6th (Urea 100 kg $ha^{-1}$and Muriate of Potash 25 kg ha^{-1}) weeks after planting (Anon. 2005).

Data collection

Numbers of leaves and roots per plant were counted on the 25th and the 45th day after sowing from a number of 15 plants which were randomly selected from each treatment. Onion bulbs were harvested at their maturity thereafter number of bulbs and their dry weights were recorded.

Statistical analysis

All collected data were statistically analyzed by analysis of variance using the Statistic Analysis System (SAS) software package. Treatment means that were significantly different were compared using Duncan's Multiple Range Test (DMRT) at 5% level.

RESULTS AND DISCUSSION

Onion growth

It was found that there were significant ($P<0.05$) differences observed in the onion growth between different treatments (Table 1). Inorganic fertilizer treated plants (T_1) exhibited quick growth of leaves at the early stage. Rate of release of nutrients are much higher in the inorganic fertilizers since they provide major elements at the early stage of plant growth and development. Thus, plants exhibited accelerated growth rate than compost treated plants. Tindall (1968) stated that relatively high levels of nutrients are required for optimum growth and development at early stage. In compost, nutrient element content is low and the nutrients are not readily available for plant uptakes (Brady, 1990). In the present study, plants treated with compost alone (T_5) showed reduced leaf development in early stage.

Table 01: The effects of application of different levels of inorganic fertilizer and compost on the growth of onion.

Treatments	Number of leaves per plant		Number of roots per plant	
	At 25th day	At 45th day	At 25th day	At 45th day
T_1	23.06 ± 5.43 a	27.13 ± 5.15	24.27 ± 8.15 a	30.06 ± 4.46
T_2	18.27 ± 4.86 b	25.73 ± 3.28	18.73 ± 4.11 b	26.46 ± 4.00
T_3	18.67 ± 3.67 b	25.60 ± 3.90	20.13 ± 6.66 ab	30.06 ± 5.95
T_4	20.93 ± 3.45 ab	22.80 ± 4.02	17.33 ± 5.14 b	23.60 ± 5.84
T_5	19.07 ± 5.20 b	25.46 ± 3.93	24.86 ± 6.20 a	28.40 ± 4.64
'F' value	*	ns	*	ns

Values represent means of 15 plants in four replications ± standard deviation.
F test: - *: P<0.05; ns- not significant.
Means followed by the same letter in each column are not significantly different according to Duncan's Multiple Range Test at 5 % level.

In later stage, leaf growth in organic manure incorporated plants was almost similar the growth rate of inorganic fertilizer treated plants, because of the availability of nutrients from the compost. Thus, inorganic fertilizers hasten early growth of onions, but that could recompense by the organic manures in the later stages. Organic manures activates many species of living organisms which release phytohormones and may stimulate the plant growth and absorption of nutrients (Arisha *et al*., 2003) and such organisms need nitrogen for multiplication (Ouda and Mahadeen, 2008). It was also noticed that there were not significant differences in the numbers of leaves and roots per plant between treatments during the later stages of growth.

Number of bulbs at harvest

Significant ($P<0.05$) differences were observed in bulb numbers between different treatments (Table 2). Higher number of bulbs (9.53) per plant was produced by T_3 meanwhile entirely inorganic fertilizer applied treatment produced low number of bulbs (6.47) per plant. It was further noticed that there were no significant differences between the treatments T_2, T_3 and T_5. Gamiely *et al.* (1991) stated that bulb size and number of bulblets formed can often be increased by additional application of nitrogen and potassium after planting. Purseglove (1972) noted that onion is a heavy feeder plant and it gives good response to organic manures. Reddy and Reddy (1998) reported that available NPK content was increased by organic manure in comparison with the chemical fertilizers.

Table 02: The effects of application of different levels of inorganic fertilizer and compost on number of bulbs per plant.

Treatments	Number of bulbs per plant at harvest
T_1	6.47 ± 2.47 b
T_2	9.13 ± 2.20 a
T_3	9.53 ± 2.45 a
T_4	6.47 ± 1.46 b
T_5	9.47 ± 2.07 a
'F' value	*

Values represent means of 15 plants in four replications ± standard deviation.
F test: - *: $P<0.05$
Means followed by the same letter are not significantly different according to Duncan's Multiple Range Test at 5 % level.

Application of organic fertilizer enhances the bulb formation in onion. Compost applied treatments had produced more number of bulbs per plants (9.47) than inorganic fertilizer applied plants (6.47). Bulb formation of onion could be affected by soil structure at the time of bulb initiation in order to enhance more number of bulbs per plants. Addition of organic fertilizer increases soil organic matter content. Activities of soil micro and macro organisms are reduced with the presence of inorganic fertilizers as compared to organic fertilizers. This is supported with the finding of Jeyarani (1986) who mentioned that addition of organic manures at the higher rate increases the total porosity significantly. Compost provides better environment for the soil organisms and enhances their activities to optimum level. Especially compost promotes actions of microorganisms in

soil. Application of compost looses soil structure; hence it is easy to form more number of bulbs per plants. It may be the probable reason for more number of bulbs per plants produced by compost applied onion plants.

Yield

It was found that there were significant differences ($P<0.05$) in the yield between different treatments (Figure 1). High yield (5.03 t ha^{-1}) was obtained from T_1 followed by T_3 (4.75 t ha^{-1}). Lowest yield was produced by T_5. It was also observed that there were no significant differences between T_1 and T_3 as well as T_1 and T_2 in yield.

Application of inorganic fertilizers gave higher yield than application of organic manure alone. Thus, inorganic fertilizers release the nutrients quickly and fulfill the plants need at the apposite time. Therefore, plants would not face any limitation during the yield forming period and it could produce better yield.

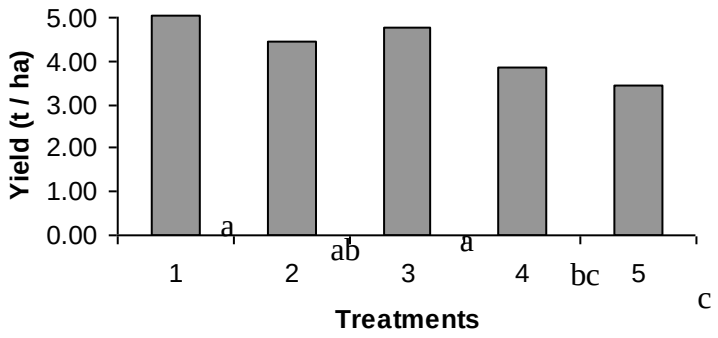

Fig. 01: The effects of different ratios of inorganic fertilizers and compost on the yield of onion. (Values are means of four replicates. Means with the same letter are not significantly different)

Inorganic fertilizers are concentrated forms of soil nutrients which can be transported much more readily than can manure. Organic manures like compost discharge nutrients very slowly to the plants and these nutrients are not directly absorb by the plants. Therefore, plants are unable access required amount of nutrients in the critical yield-forming period. This may be the probable reason for the higher yield produced by the inorganic fertilizer applied onion. However, there is no significant difference in the yield between treatments T_1 and T_3. In T_3, half fold of recommended inorganic fertilizers and half fold of organic (compost) manure were applied as basal dressing. Also, nutrients released by the compost would have contributed for the final yield along with the nutrients from inorganic fertilizer. It may be the possible reason for the high yield produced by this treatment. Thus, combination of organic and inorganic fertilizers could produce better yields than organic manure alone. The present result agreed with previous findings obtained on onion (Abbey and Kanton, 2004; Gambo *et al.*, 2008), tomato (Babajide *et al.*, 2008) and broccoli (Ouda and Mahadeen, 2008).

CONCLUTION

This experiment demonstrated the effects of different levels of compost and inorganic fertilizers in the yield of onion. Inorganic fertilizer treated plants exhibited quick growth at early stage, but compost applied plants recaptured that growth rate in later stages. It was also noted that compost enhanced number of bulbs per plant. From the results of this investigation, it was found that half fold of recommended inorganic fertilizers and compost at the rate of 4 t ha^{-1} could give profitable yield and this combination could possibly reduce the cost of production in the onion cultivation.

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