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# Effect of foliar application of urea as top dressing on yield of radish (*Raphanus sativus* L.) in sandy regosol

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**Abstract**

*A study was conducted to evaluate the effect of foliar application of urea on cultivation of radish (Raphanus sativus L.) in sandy regosol. This experiment was laid out in a Randomized Complete Block Design with five treatments and four replications. The treatments included recommended soil application of urea as top dressing without ($T_1$) and with the additional foliar application ($T_2$) and also the recommended rate of urea ($T_1$) reduced to 3/4, 1/2 and 1/4 with the foliar application ($T_3$, $T_4$ and $T_5$ respectively). Urea (0.1%) was applied as foliar spray in all the treatments except control ($T_1$). The results showed that there were no significant differences in leaf parameters such as leaf area index, number of leaves and leaf length and also in the tuber parameters such as length and diameter of tuberous root among the treatments. Significant difference was observed in fresh and dry weights of leaves between $T_1$ and $T_3$. There were remarkable differences in fresh and dry weights of tuberous root between $T_1$ and $T_5$. In the present study, the half recommended rate of urea applied to soil in combination with 0.1% foliar urea spray was the more suitable practice of urea application as top dressing among the treatments. It is an economical and fertilizer saving practice compared to control.*

***Keywords***: *Foliar application, radish, soil application, top dressing, urea.*

## INTRODUCTION

Radish (*Raphanus sativus*) is an edible root vegetable of the Brassicaceae family. It is a popular vegetable in both tropical and temperate regions and used as vegetable or salad in Sri Lanka. Radish is one of the most ancient vegetables and both roots and leaves of radish are good sources of calcium, phosphorus and ascorbic acid and also rich in folic acid and potassium. It is a rapidly maturing crop and fairly easy to grow. The most popular part for

eating is the root although the entire plant is edible and the tops can be used as a leafy vegetable.

Application of nitrogen fertilizer to supply enough nitrogen for crop production is a common practice for farmers nowadays. On the other hand, intensive use of nitrogen fertilizer in developed countries has caused serious environmental problems [1]. Foliar feeding is an effective method for correcting soil deficiencies and overcoming the soils inability to transfer nutrients to the plant [2]. Application of nitrogen fertilizer usually gives a rapid, visual increase in plant growth and the use of nitrogen fertilizers has been essential to increase the productivity of agriculture. Foliar fertilizer is used throughout the world as both a preventive and a curative measure as it is able specifically to compensate for nutrient deficiency [3]. Foliar nutrient application has proved to be an important method of fertilizer application with the specific aim of reducing or remedying nutrient deficiency.

Although foliar fertilization gives the emphasis on trace elements, it has repeatedly been shown under different practical cultivation conditions where foliar application of macro elements also has a positive effect on plant metabolism and thus promotes yield. The amount of nutrient incorporated via foliar fertilization is considerably less than can be absorbed by the roots [3]. Urea is not only absorbed but also translocated by the plant in the form of urea itself [4] and it is the most effective form of nitrogen for foliar application [5]. Urea supplies 46% N, helps to reduce handling, storage and transportation costs over other dry N forms. And its manufacture releases few pollutants to the environment. Spraying nitrogen in the form of urea solution is widely used. Crop responses to nutrient spray is quicker, but also more temporary than its response to soil application [6]. The application of nutrients via the leaves can quickly counter a mineral imbalance that would inhibit plant metabolism and thus promote the efficiency of the nutrients absorbed through the roots [3]. Therefore, this study was done to perform the effect of foliar application of urea on yield of radish *(Raphanus sativus* L.) in sandy regosol.

## MATERIALS AND METHODS

### Location and Climatic condition

This experiment was conducted at the Agronomy farm of Eastern University, Sri Lanka in 2007/2008. Agronomy farm located in the latitude of 7° 43' and the longitude of 81° 42'E. It belongs to the agro-ecological region of low country dry zone in Sri Lanka. The soil texture of the experimental area is sandy which shows neutral reaction and it was added with organic manure during land preparation in order to obtain desirable structure for the

germination. This region has the temperature range of 28-32$^0$C and relative humidity of 54-60% and receives annual rainfall of 1800-2100 mm.

**Treatments**

This experiment had five treatments ($T_1$ - $T_5$) as follows:

$T_1$ - Recommended rate of urea applied to soil as a control.

$T_2$ - Recommended rate of urea applied to soil and 0.1% urea solution applied as foliar spray.

$T_3$ - 3/4 recommended rate of urea applied to soil and 0.1% urea solution applied as foliar spray.

$T_4$ - 1/2 recommended rate of urea applied to soil and 0.1% urea solution applied as foliar spray.

$T_5$ - 1/4 recommended rate of urea applied to soil and 0.1% urea solution applied as foliar spray.

Urea at the rate of 90 kg/ha ($T_1$) was applied to soil at the time of top dressing as recommended by the Department of Agriculture, Sri Lanka.

**Experimental design and Planting**

The experimental design used was a Randomized Complete Block Design with five treatments and four replications. Treatments were randomly assigned to each block. Radish cv. Japan ball was used and seeds were planted at a spacing of 30 cm between rows and 10 cm within plants. Prior to sowing, the germination test was carried out and the germination of seed stock was 80%. Thinning out was done two weeks after sowing.

**Cultural practices**

The basal application of fertilizers was done at the day before sowing and top dressing was practiced at 3$^{rd}$ week after sowing according to the recommendation of Department of Agriculture, Sri Lanka. The recommended fertilizers for basal application were urea (90 kg/ha), triple super phosphate (TSP - 110 kg/ha) and muriate of potash (MOP - 65 kg/ ha). At the time of top dressing, both urea and MOP were applied at the rates of 90 kg/ha and 65 kg/ha respectively.

In this experiment, the recommended rate of urea was reduced to 3/4, 1/2 and 1/4 recommendations in different treatments to study the combined effect of foliar application of 0.1 % urea solution in combination with urea applied to soil on yield of radish. The foliar application was practiced in $T_2$, $T_3$, $T_4$ and $T_5$ with the aid of small hand operated sprayer (capacity 1000 ml) and it was not applied to $T_1$ where the only recommended fertilizer applied to soil as a control. Muriate of potash has applied to all the treatments as in the

recommendation. Only the urea fertilizer was considered as a reduced top dressing. Foliar application was done twice at 3rd and 4th weeks of planting.

Watering was practiced twice a day until 4th week of sowing. Then it was practiced once in a day until harvesting by means of watering pumps. There were no pest attacks found during radish cultivation at the Agronomy farm. However, the incidence of diseases was identified due to the fungus attack. This was controlled by the application of fungicide. Weed control was practiced manually at two weeks intervals.

**Measurements**

Parameters taken in this study were leaf area, leaf number, leaf width and length, diameter and length of tuberous root and other parameters such as total length of the roots including tuberous root length. Further, fresh and dry weights of tuberous root and leaves were measured separately. Ten plants were randomly selected from each plot for the measurement.

## RESULTS AND DISCUSSION

**Leaf formation**

Among the treatments, there were no significant differences observed in the number of leaves and length of leaves meanwhile there was significant difference observed in leaf width. Leaf width in $T_3$ was remarkably higher than that in $T_5$. Foliar application was practiced in $T_3$ and $T_5$. In $T_3$, soil applied urea was reduced to 3/4th and in $T_5$ it was reduced to 1/4th. Balanced amounts of macro elements must be supplied via the roots and under optimum root fertilization conditions, the crop yield increases when an additional foliar spray is applied [3].

**Leaf area index**

A useful measure of the relative leaf area of a plant is the leaf area index (LAI). In this experiment, the leaf area was measured at two week intervals. The results showed that there was no significant ($P<0.05$) difference in LAI among the treatments. LAI ranges from 1 to 8 according to species and the habitat of the plant [7]. From all the treatments, the LAI was estimated between the range of 4.0 -5.5.

**Tuberous root formation**

There were no significant differences observed in tuberous root diameter, tuberous root length and total root length among the treatments. Sadhu [8] reported that the application of 75 kg N and 80 kg P per ha resulted in greater diameter and higher root yield in radish. In the present study, only 90 kg of urea/ha was applied as top dressing in control which provides nearly 41 kg of nitrogen.

**Fresh weight of plant**

The results showed that there were significant differences in fresh weights of tuberous roots and leaves among the treatments (Table 1). Tuberous root weight in $T_5$ was remarkably low compared to other treatments. Even though foliar application has given, the reduction in the weight of tuberous root in $T_5$ would be due to the reduction of the recommended soil fertilization upto 1/4$^{th}$. This is supported by Alexander [3] that balance amounts of macro elements must be supplied via the roots and under optimum root fertilization conditions, the crop yield increases when an additional foliar spray is applied. Their resistance promoting effect has a positive contribution towards the increase in yield and improvement in quality in the important constituent materials of harvested crop. $T_2$ had both foliar and recommended soil applications. The weight increased in $T_2$ compared to $T_5$ would be due to the above reason and supported by Alexander [3]. The resultant increase in efficiency is an important economic factor especially for foliar nutrient application.

**Table 1.** Fresh weight of tuberous root and leaves of radish plant at the time of harvest

| Treatment | Tuberous root weight (g) | Leaves weight (g) |
|---|---|---|
| $T_1$ | 137.50 ± 3.67 a | 71.25 ± 9.65 b |
| $T_2$ | 142.50 ± 3.19 a | 85.00 ± 5.26 ab |
| $T_3$ | 116.25 ± 9.44 ab | 92.50 ± 6.61 a |
| $T_4$ | 120.00 ± 5.24 ab | 83.75 ± 2.31 ab |
| $T_5$ | 92.50 ± 1.97 b | 68.75 ± 5.73 b |
| F test | P<0.05 | P<0.05 |

Value represents mean ± standard error.

Means followed with the same letter in each column are not significantly different at 5% level according to the Duncan's Multiple Range Test.

In case of fresh weight of leaves, significant difference was observed between $T_1$ and $T_3$. In $T_3$ the recommended amount of soil fertilization was reduced to 3/4$^{th}$. The weight increase in $T_3$ compared to $T_1$ would be due to the reduction of soil fertilizer and the provision of additional foliar fertilizer. This is supported by Alexander [3] who reported that the increased yield achieved can be related to the reduction in the amount of mineral fertilizer used. The foliar nutrition in addition to soil application of fertilizer increased the yield of Japanese white radish [8].

**Dry weight of plant**

Mandal [9] reported that dry matter is accumulated more in leaves during the first 3 to 4 months of growth and afterwards accumulated more in the tuberous root crops. The results showed that there were significant differences in dry weights of tuberous roots and leaves among the treatments (Table 2). The changes in dry weight also were same as in fresh weight. The dry weight of tuberous roots was remarkably low in $T_5$ compared to control ($T_1$). In case of fresh weight of leaves, significant difference was observed between $T_1$ and $T_3$.

**Table 2:** Dry weight of tuberous root and leaves of radish at the time of harvest

| Treatment | Tuberous root weight (g) | Leaves weight (g) |
|---|---|---|
| $T_1$ | 111.25 ± 5.02 a | 35.64 ± 1.42 b |
| $T_2$ | 114.53 ± 3.67 a | 45.06 ± 1.21 ab |
| $T_3$ | 94.41 ± 2.66 ab | 52.29 ± 1.17 a |
| $T_4$ | 94.97 ± 2.54 ab | 41.72 ± 1.58 ab |
| $T_5$ | 74.37 ± 3.07 b | 31.18 ± 1.48 b |
| F test | P<0.05 | P<0.05 |

Value represents mean ± standard error.

Means followed with the same letter in each column are not significantly different at 5% level according to the Duncan's Multiple Range Test.

**Yield**

There was no significant difference (P<0.05) observed in yield of radish among the treatments. The yield consists of both tuberous root and leaf yield. When the tuberous root yield is concerned, no significant difference observed between control ($T_1$) and recommended rate with foliar applied treatment ($T_2$). However, tuberous root weight was slightly high in $T_2$. It is noted that the tuberous root weight depends on the combination of both soil and foliar applications. Significant difference was observed between control and 1/4 recommended rate with foliar applied treatment ($T_5$). This shows extreme reduction in recommended soil fertilizer does not cause satisfactory root growth with the application of foliar fertilizer. The growth of radish plants was checked most severely due to lack of N or Ca [8]. Tap root development was practically nil without N, K or Ca, poor without P or Mg and almost normal without any of the other nutrient elements [8]. Foliar urea application would be an advisable treatment that produces higher yields in broccoli [10].

The foliar fertilization is effective when applied with optimum soil fertilization. In the present study, there was no significant difference observed in tuberous root yield of radish among the treatments except $T_5$. Recommended fertilizer with foliar spray ($T_2$) is suitable practice when radish yield is concerned. The resultant increase in efficiency is an important economic factor, especially for foliar nutrient application under arid and semi arid conditions [3]. When the leaf or tuberous root yield is concerned no significant difference observed between the control ($T_1$) and recommended rate with foliar application ($T_2$) or between $T_1$ and 1/2 recommended rate with foliar application ($T_4$). The result indicated that the yield was also significantly affected when reducing the soil fertilizer to 1/4 recommendation. And also foliar fertilization with optimum soil fertilization has the impact on increasing the leaf and tuberous root yield rather than applying soil fertilizer alone. The foliar nutrition in addition to soil application of fertilizer increased the yield of Japanese white radish [8]. In the present study, 1/2 recommendation with foliar application is an economic way of saving the fertilizers. Giskin *et al.* [11] reported that the efficient use of foliar fertilization can achieve a 25% saving in the recommended quantity of mineral fertilizer on common bean (*Phaseolus vulgaris).*

The radish is grown as an annual for its enlarged flesh tap root [12]. Radish is grown for its young tender tuberous roots which are eaten raw as salad or cooked as a vegetable [8]. The tuber weight is remarkably higher in $T_2$ where the recommended soil urea applied with foliar application. But there was no significant difference among $T_1$, $T_2$, $T_3$ and $T_4$. Therefore, in an economic view, 1/2 recommended rate with foliar application ($T_4$) is suitable. In $T_4$, fresh weight of leaf was high and the tops can be used as a leafy vegetable and also it minimized the fertilizer use in the cultivation of Radish.

## CONCLUSION

In the present study, the suitable practice of fertilizer application was the half recommended rate of urea applied to soil in combination with the foliar spray of 0.1% urea ($T_4$) as top dressing. The $T_4$ had no significant differences in yield of radish compared to control and also is economical when the cost of fertilizer is concerned. The amount of recommended fertilizer could be reduced and thereby it is possible to save the fertilizer. Therefore, it is an economical to use half recommended rate of urea applied to soil in combination with 0.1% urea foliar spray on the cultivation of radish in sandy regosol.

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