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# RESPONSE OF STRAWBERRY TO NPKS ON YIELD IN TERRACE SOIL

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## Abstract

Strawberry (*Fragaria X annanassa* Duch.) is highly exhaustive and responsive to chemical fertilizers. An experiment on strawberry was conducted in fruits research field of Horticulture Research Centre, BARI, Gazipur over three consecutive years, 2009-2010, 2010-2011 and 2011-2012 to find out the suitable combination of nitrogen (N), phosphorus (P), potassium (K) and sulphur (S) for yield maximization of strawberry. Fourteen treatment combinations were tested in this trial comprising four levels each of N (0, 90, 115 and 140 kg $ha^{-1}$), P (0, 20, 40 and 60 kg $ha^{-1}$), K (0, 85, 110 and 135 kg $ha^{-1}$) and S (0, 15, 25 and 35 kg $ha^{-1}$) with blanket dose of 4 kg Zn $ha^{-1}$, 2 kg B $ha^{-1}$ and 10 t cowdung $ha^{-1}$. The experiment was set up in randomized completely block design with three replications. Results showed that treatment combination $N_{115}P_{40}K_{110}S_{25}$ (underscript represent kg $ha^{-1}$) produced higher strawberry fruit yield (9.59 t $ha^{-1}$) followed by $N_{90}P_{40}K_{110}S_{25}$ kg $ha^{-1}$ and $N_{140}P_{40}K_{110}S_{25}$ kg $ha^{-1}$ treatment combinations. The lowest fruit yield (6.05 t $ha^{-1}$) was found in control ($N_0P_0K_0S_0$) treatment. Therefore, the combination of $N_{115}P_{40}K_{110}S_{25}$ kg $ha^{-1}$ may be considered as suitable dose for strawberry cultivation in terrace soils of Bangladesh.

Keywords: Fertilizer (N, P, K and S), strawberry yield, terrace soil.

## Introduction

Strawberry (*Fragaria X annanassa* Duch.) belongs to rose family. It is a good source of vitamin C, folate and potassium, and is relatively low in calories. Excellent ice cream and jam or jellies are made with strawberry due to its attractiveness, tasty, pleasant aroma and flavor (Rayees *et al*., 2015). Strawberry has attained a premier position in the fresh fruit market and processing industries of the world (Sharma and Sharma, 2003). Although it is widely grown in temperate zones, its cultivation is also possible in the sub-tropical zones as day neutral cultivars (Asrey and Singh, 2004). Strawberry offers quicker returns than any other fruit crop.

Most of the soils and climatic conditions of Bangladesh are suitable for strawberry production. Cultivation of this fruit has started in Bangladesh. However, the average yield is lower compared to the other sub-tropical countries,

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imbalance fertilization and poor agronomic practices being one of the best reasons. On the other hand, excess use of chemical fertilizers, pesticides and herbicides renders adverse effects on soil health and environment quality (Macit *et al.,* 2007). For sustainable crop yields, balanced fertilizations with all the nutrients (major and trace) that are deficient in soils need to be taken into account. Role of nitrogen involves in vigorous vegetative growth with dark green color. It is a constituent of protein and nucleic acids and an integral part of chlorophyll. Plant cells need to have adequate phosphorus before they divide. Phosphorus increases root growth, yield, enhances plant maturity and promotes resistance to root rot disease and winter kill (Norfleet, 1998). Potassium is associated with activation of enzymes related to starch synthesis, regulation of stomata openings, imparts disease, cold and drought resistance to plants. Sulphur is a constituent of some amino acids, biotin and coenzyme. It is involved in chlorophyll synthesis (FRG, 2012).

Farmers of Bangladesh usually use fertilizers based on their own estimate without thinking of balance fertilization which causes deterioration of soil fertility. As intensive crop cultivation is becoming more and more necessary to meet the demand of the over population, the soil nutrient balance is becoming increasingly negative and thus requiring appropriate supplement through balanced nutrient management. We do not have yet any recommended dose of fertilizers for boosting fruit yield of strawberry in the BARC published Fertilizer Recommendation Guide. Hence, the experiment was undertaken to determine the dose of N, P, K and S for yield maximization of strawberry in terrace soils of Bangladesh.

## Materials and Methods

The experiment was done at the fruits research field of Horticulture Research Centre, BARI, Gazipur during *rabi* season of 2009-10, 2010-11 and 2011-12 to find out the suitable combination of N, P, K and S for yield maximization of strawberry. The experimental site (24° 0′ 13″ N latitude and 90° 25′ 0″ E longitude) lies at an elevation of 8.4 m above the sea level. The Gazipur soil belongs to Chhiata series (Soil taxonomy: Udic Rhodustalf) under the agroecological zone Madhupur Tract, the soil texture being clay loam. There were 14 treatment combinations comprising four levels each of N (0, 90, 115 and 140 kg $ha^{-1}$), P (0, 20, 40 and 60 kg $ha^{-1}$), K (0, 85, 110 and 135 kg $ha^{-1}$) and S (0, 15, 25 and 35 kg $ha^{-1}$). A blanket dose of fertilizer viz. $Zn_{4.0}B_{2.0}$ kg $ha^{-1}$ and 10 t $ha^{-1}$cowdung were used in the trial. The arrangement of treatment combinations is shown in Table 1. Soil samples (0-15 cm) before initiation of the experiment was analyzed for soil pH (Jackson, 1973), organic matter (Nelson and Sommers,1982), total N (Bremner and Mulvaney, 1982), exchangeable K (Jackson, 1973), exchangeable Ca & Mg (Gupta, 2004), available P (Olsen & Sommers, 1982), available S (Fox *et al*., 1964), available Zn (Lindsay and

Norvell, 1978), available B (Page *et al*., 1982). The results of the soil properties are shown in Table 2.

The land was prepared thoroughly by a tractor driven siezel and rotavator. The experiment was laid out in randomized completely block design with three replications. The unit plot size was 2.5 m × 1 m along with crop spacing of 50 cm x 50 cm. Nitrogen, P, K, S, Zn and B were supplied as urea, TSP, MoP, gypsum, zinc sulphate and boric acid fertilizer, respectively. Zinc sulphate, boric acid and cowdung were applied to all plots at the time of final land preparation. Triple super phosphate, gypsum and 50% MoP were added in the respective plots during final bed preparation. Fourty five days old strawberry (var. BARI Strawberry-1) seedlings were transplanted on 20 December 2009, 19 December 2010 and 21 December 2011. Urea and 50% MoP were supplied in three equal splits after 15, 30 and 45 days of transplanting, respectively. Intercultural operations were done as and when required. Data on the number of fruits per plant, length, diameter, fruit weight per plant and individual fruit weight were recorded from eight randomly selected plants. All data on different parameters were computed for statistical analysis and the mean comparisons were adjusted by DMRT at 5% level of significance.

**Table 1. Fertilizer rate wise treatment arrangement**

| Treatment | Subscripts represent kg $ha^{-1}$ | Treatment | Subscripts represent kg $ha^{-1}$ |
|---|---|---|---|
| $T_1$ | $N_0P_{40}K_{110}S_{25}$ | $T_8$ | $N_{115}P_{40}K_0S_{25}$ |
| $T_2$ | $N_{90}P_{40}K_{110}S_{25}$ | $T_9$ | $N_{115}P_{40}K_{85}S_{25}$ |
| $T_3$ | $N_{115}P_{40}K_{110}S_{25}$ | $T_{10}$ | $N_{115}P_{40}K_{135}S_{25}$ |
| $T_4$ | $N_{140}P_{40}K_{110}S_{25}$ | $T_{11}$ | $N_{115}P_{40}K_{110}S_0$ |
| $T_5$ | $N_{115}P_0K_{110}S_{25}$; | $T_{12}$ | $N_{115}P_{40}K_{110}S_{15}$ |
| $T_6$ | $N_{115}P_{20}K_{110}S_{25}$ | $T_{13}$ | $N_{115}P_{40}K_{110}S_{35}$ |
| $T_7$ | $N_{115}P_{60}K_{110}S_{25}$ | $T_{14}$ | $N_0P_0K_0S_0$ |

**Table 2. Soil properties of the experimental field**

| Location | pH | OM (%) | Ca | Mg | K | Total N (%) | P | S | B | Zn |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | meq/100g | | | | µg/g | | | |
| Joydebpur | 6.3 | 0.95 | 1.12 | 0.60 | 0.17 | 0.068 | 9 | 15 | 0.1 | 1.3 |
| Critical level (FRG, 2012) | - | - | 2.0 | 0.5 | 0.12 | 0.12 | 10 | 10 | 0.2 | 0.6 |

## Results and Discussion

### Yield contributing characters

Combination of N, P, K and S showed significant influence on yield contributing characters of strawberry in all three years (Tables 3 & 4). The number of fruits

per plant and fruit length (mean of three years) ranged from 9.95-15.6 and 3.96-3.11 cm, respectively. The maximum number of fruits per plant was recorded from the combination of $N_{115}P_{40}K_{110}S_{25}$ ($T_3$) which was significantly different from the other treatment combinations, but statistically identical with $T_2$ and $T_4$ treatments in every year. Result of fruit length showed a similar trend. Similar results were reported by Klaas (2000) and Funt and Blerman (2000). The minimum number of fruit per plant and the lowest fruit length were recorded from the $T_{14}$ treatment ($N_0P_0K_0S_0$) (Table 3).

Different combination of N, P, K and S contributed significant role on fruit diameter and fruit weight per plant of strawberry in three following years. Mean fruit diameter varied from 2.17-3.31 cm. The highest fruit diameter (3.31) was recorded from $T_3$ treatment ($N_{115}P_{40}K_{110}S_{25}$) followed by $T_4$ and $T_2$, while the minimum was recorded from the $T_{14}$ ($N_0P_0K_0S_0$). Mean fruit weight per plant varied from 145.9-237.6 g where the highest fruit weight per plant was found in $T_3$ treatment ($N_{115}P_{40}K_{110}S_{25}$) followed by $T_4$ and $T_2$. The lowest fruit diameter was observed in $N_0P_0K_0S_0$ treatment (Table 4). These findings are in agreement with Arancon *et al*. (2004), Singh and Dwivedi (2011).

**Table 3. Effects of different combinations of N, P, K and S on fruits plant$^{-1}$ and fruit length of strawberry**

| Treatments (kg ha$^{-1}$) | Fruits plant$^{-1}$ | | | | Fruit length (cm) | | | |
|---|---|---|---|---|---|---|---|---|
| | 2010 | 2011 | 2012 | mean | 2010 | 2011 | 2012 | mean |
| $T_1$= $N_0P_{40}K_{110}S_{25}$ | 17.5def | 8.33gh | 8.15gh | 11.3 | 3.26e | 3.09cd | 3.24cd | 3.20 |
| $T_2$= $N_{90}P_{40}K_{110}S_{25}$ | 19.2a-e | 11.75ab | 11.55ab | 14.2 | 3.64abc | 3.82abc | 3.97a-c | 3.81 |
| $T_3$= $N_{115}P_{40}K_{110}S_{25}$ | 21.8a | 12.55a | 12.35a | **15.6** | 3.72a | 4.01a | 4.16a | **3.96** |
| $T_4$= $N_{140}P_{40}K_{110}S_{25}$ | 20.4abc | 12.05ab | 11.85ab | 14.8 | 3.69a | 3.92ab | 4.08ab | 3.90 |
| $T_5$= $N_{115}P_0K_{110}S_{25}$ | 17.6def | 8.68fgh | 8.45f-h | 11.6 | 3.47d | 3.12cd | 3.26cd | 3.28 |
| $T_6$= $N_{115}P_{20}K_{110}S_{25}$ | 18.1b-e | 10.15cde | 9.95c-e | 12.7 | 3.70a | 3.35a-d | 3.48a-d | 3.51 |
| $T_7$= $N_{115}P_{60}K_{110}S_{25}$ | 19.1a-e | 10.85bcd | 10.65b-d | 13.5 | 3.56bcd | 3.52a-d | 3.65a-d | 3.58 |
| $T_8$= $N_{115}P_{40}K_0S_{25}$ | 19.9a-d | 9.19efg | 9.05e-g | 12.7 | 3.44d | 3.19bcd | 3.35b-d | 3.33 |
| $T_9$= $N_{115}P_{40}K_{85}S_{25}$ | 20.7ab | 9.82def | 9.65d-f | 13.4 | 3.55cd | 3.29a-d | 3.45a-d | 3.43 |
| $T_{10}$= $N_{115}P_{40}K_{135}S_{25}$ | 17.8c-f | 11.45abc | 11.25a-c | 13.5 | 3.46d | 3.76a-d | 3.90a-d | 3.71 |
| $T_{11}$= $N_{115}P_{40}K_{110}S_0$ | 16.5ef | 9.53d-g | 9.35d-g | 11.8 | 3.65abc | 3.25a-d | 3.41a-d | 3.44 |
| $T_{12}$= $N_{115}P_{40}K_{110}S_{15}$ | 19.8a-d | 11.25abc | 11.05a-c | 14.0 | 3.71a | 3.65a-d | 3.78a-d | 3.71 |
| $T_{13}$= $N_{115}P_{40}K_{110}S_{35}$ | 19.4a-e | 10.35cde | 10.35c-e | 13.4 | 3.68ab | 3.43a-d | 3.56a-d | 3.56 |
| $T_{14}$= $N_0P_0K_0S_0$ | 15.3f | 7.38h | 7.15h | 9.95 | 3.16e | 3.02d | 3.15d | 3.11 |
| CV (%) | 7.52 | 5.91 | 6.42 | - | 5.11 | 9.88 | 8.85 | - |

Values within a same column with a common letter do not differ significantly (p=0.05) by DMRT.

**Table 4. Effects of different combinations of N, P, K and S on fruits diameter and fruit wt. plant$^{-1}$ of strawberry**

| Treatments (kg ha$^{-1}$) | Fruit diameter (cm) | | | | Fruit wt. plant$^{-1}$ (g) | | | |
|---|---|---|---|---|---|---|---|---|
| | 2010 | 2011 | 2012 | mean | 2010 | 2011 | 2012 | mean |
| $T_1$= $N_0P_{40}K_{110}S_{25}$ | 2.90b-e | 2.32gh | 2.35gh | 2.52 | 237.3a-e | 132.6gh | 142.6gh | 170.8 |
| $T_2$= $N_{90}P_{40}K_{110}S_{25}$ | 2.98bc | 3.21ab | 3.25ab | 3.15 | 282.7abc | 190.6abc | 199.6a-c | 224.3 |
| $T_3$= $N_{115}P_{40}K_{110}S_{25}$ | 3.17a | 3.35a | 3.41a | **3.31** | 292.7a | 205.1a | 215.1a | **237.6** |
| $T_4$= $N_{140}P_{40}K_{110}S_{25}$ | 2.93b-e | 3.25ab | 3.29ab | 3.16 | 284.0ab | 199.9ab | 205.9ab | 229.9 |
| $T_5$= $N_{115}P_0K_{110}S_{25}$ | 2.87de | 2.44fgh | 2.48f-h | 2.60 | 216.7de | 138.4fgh | 145.4f-h | 166.8 |
| $T_6$= $N_{115}P_{20}K_{110}S_{25}$ | 2.96bcd | 2.85b-f | 2.88b-f | 2.90 | 254.7a-d | 158.3c-g | 165.4c-g | 192.8 |
| $T_7$= $N_{115}P_{60}K_{110}S_{25}$ | 2.97bcd | 3.02a-d | 3.08a-d | 3.02 | 262.7a-d | 172.9a-f | 180.9a-f | 205.5 |
| $T_8$= $N_{115}P_{40}K_0S_{25}$ | 2.88cde | 2.52e-h | 2.55e-h | 2.65 | 231.3b-e | 143.4fgh | 152.4f-h | 175.7 |
| $T_9$= $N_{115}P_{40}K_{85}S_{25}$ | 2.90b-e | 2.72c-g | 2.75c-g | 2.79 | 236.7 a-e | 151.3d-h | 160.4d-h | 182.8 |
| $T_{10}$= $N_{115}P_{40}K_{135}S_{25}$ | 2.99b | 3.15abc | 3.18a-c | 3.11 | 277.3abc | 185.8a-d | 195.8a-d | 219.6 |
| $T_{11}$= $N_{115}P_{40}K_{110}S_0$ | 2.84e | 2.65d-g | 2.68d-g | 2.72 | 227.3cde | 147.6e-h | 155.6e-h | 176.8 |
| $T_{12}$= $N_{115}P_{40}K_{110}S_{15}$ | 2.93b-e | 3.09a-d | 3.12a-d | 3.05 | 276.7abc | 178.7a-e | 158.7a-e | 204.7 |
| $T_{13}$= $N_{115}P_{40}K_{110}S_{35}$ | 2.95bcd | 2.92a-e | 2.95a-e | 2.94 | 260.0 a-d | 168.3b-g | 175.3b-g | 201.2 |
| $T_{14}$= $N_0P_0K_0S_0$ | 2.21f | 2.15h | 2.16h | 2.17 | 194.0e | 118.3h | 125.3h | 145.9 |
| CV (%) | 5.90 | 6.87 | 7.25 | 6.67 | 7.65 | 9.40 | 8.45 | 8.5 |

Values within a same column with a common letter do not differ significantly (p=0.05) by DMRT.

## Fruit yield

Table 5 shows that combined application of NPKS fertilizers had a significant effect on individual fruit weight and fruit yield of strawberry. The highest fruit weight (mean 16.68 g) and fruit yield (mean 9.59 t ha$^{-1}$) were obtained with the application of $N_{115}P_{40}K_{110}S_{25}$ treatment ($T_3$) and the lowest values were noted with $N_0P_0K_0S_0$ treatment ($T_{14}$). The highest yield was statistically similar with the yield recorded by treatments $T_2$ ($N_{90}P_{40}K_{110}S_{25}$) and $T_4$ ($N_{140}P_{40}K_{110}S_{25}$). The maximum fruit yields produced by these treatments can be attributed to cumulative effect of the number of fruits per plant and individual fruit weight. Comparable results were reported by other workers (Koszanski *et al.*, 2002, Mahaveer *et al.*, 2004).

**Table 5. Effects of different combinations of N, P, K and S on fruit weight and fruit yield of strawberry**

| Treatments (kg ha$^{-1}$) | Individual fruit wt. (g) | | | | Fruit yield (t ha$^{-1}$) | | | |
|---|---|---|---|---|---|---|---|---|
| | 2010 | 2011 | 2012 | mean | 2010 | 2011 | 2012 | mean |
| $T_1$= $N_0P_{40}K_{110}S_{25}$ | 15.85ab | 10.85gh | 12.80gh | 13.17 | 9.49def | 5.98ef | 5.95ef | 7.14 |
| $T_2$= $N_{90}P_{40}K_{110}S_{25}$ | 16.25a | 14.85abc | 16.80a-c | 15.97 | 11.31abc | 8.15ab | 8.10ab | 9.19 |
| $T_3$= $N_{115}P_{40}K_{110}S_{25}$ | 16.29a | 15.90a | 17.85a | **16.68** | 11.71a | 8.55a | 8.50a | **9.59** |
| $T_4$= $N_{140}P_{40}K_{110}S_{25}$ | 15.81ab | 15.45ab | 17.40ab | 16.22 | 11.36ab | 8.35ab | 8.32ab | 9.34 |
| $T_5$= $N_{115}P_0K_{110}S_{25}$ | 14.12cde | 11.25fgh | 13.20f-h | 12.86 | 8.67fg | 6.18def | 6.15d-f | 7.00 |
| $T_6$= $N_{115}P_{20}K_{110}S_{25}$ | 15.52ab | 13.25b-f | 15.20b-f | 14.66 | 10.19cde | 7.12a-e | 7.15a-e | 8.15 |
| $T_7$= $N_{115}P_{60}K_{110}S_{25}$ | 15.70ab | 13.95a-e | 15.90a-e | 15.18 | 10.51bcd | 7.45a-e | 7.48a-e | 8.48 |
| $T_8$= $N_{115}P_{40}K_0S_{25}$ | 13.94de | 11.78efg | 13.75e-g | 13.16 | 7.92g | 6.35def | 6.38d-f | 6.88 |
| $T_9$= $N_{115}P_{40}K_{85}S_{25}$ | 15.83ab | 12.88c-g | 14.85c-g | 14.52 | 9.46def | 6.88b-e | 6.90b-e | 7.75 |
| $T_{10}$= $N_{115}P_{40}K_{135}S_{25}$ | 14.95bcd | 14.45a-d | 16.40a-d | 15.27 | 11.09abc | 7.95abc | 7.95a-c | 9.00 |
| $T_{11}$= $N_{115}P_{40}K_{110}S_0$ | 15.17abc | 12.45d-g | 14.35d-g | 13.99 | 9.09ef | 6.59c-f | 6.62c-f | 7.43 |
| $T_{12}$= $N_{115}P_{40}K_{110}S_{15}$ | 15.47ab | 14.15a-d | 16.10a-d | 15.24 | 11.07abc | 7.65a-d | 7.68a-d | 8.80 |
| $T_{13}$= $N_{115}P_{40}K_{110}S_{35}$ | 15.96ab | 13.65a-e | 15.55a-e | 15.05 | 10.40bcd | 7.22a-e | 7.25a-e | 8.29 |
| $T_{14}$= $N_0P_0K_0S_0$ | 13.48e | 9.15h | 11.10h | 11.24 | 7.76g | 5.18f | 5.20f | 6.05 |
| CV (%) | 7.63 | 7.69 | 7.9 | 7.74 | 8.99 | 9.38 | 9.95 | 9.44 |

Values within a same column with a common letter do not differ significantly (p=0.05) by DMRT.

### Single effect of N, P, K and S on strawberry yield

Single effects of N application positively increased strawberry yield during 2010, 2011 and 2012 (Table 6). The average fruit yield varied from 7.11-9.59 t ha$^{-1}$, where the highest yield (9.59 t ha$^{-1}$) was found in 115 kg N ha$^{-1}$ and the lowest yield (7.11 t ha$^{-1}$) in $N_0$. The highest yield was 37% increase over N control. Similar results were reported by Abu-Zahra and Tahboub (2008). Results indicated that the dose above or below 115 kg N ha$^{-1}$ rate suppressed the potential yield of strawberry. Positive effect of P was also noticed on yield increase of strawberry (Table 6). The average fruit yield varied from 7.00-9.59 t ha$^{-1}$ where the highest yield (9.59 t ha$^{-1}$) was found in 40 kg P ha$^{-1}$ and the lowest (7.00 t ha$^{-1}$) in $P_0$. Strawberry yield increased with the increasing level of phosphorus as reported by Yusuf *et al.* (2003) and Mohamed *et al.* (2011). Different levels of K application also demonstrated positive influence on strawberry yield (Table 6). The average fruit yield ranged from 6.88-9.59 t ha$^{-1}$, the highest yield (38% yield increase over K control) was noted in 110 kg K ha$^{-1}$ and the lowest (6.88 t ha$^{-1}$) yield was in $K_0$. The average fruit yield due to S effect was from 7.43-9.59 t ha$^{-1}$(Table 6). The highest yield which was 29% yield increase over S control was

observed in 25 kg S $ha^{-1}$ and the lowest (7.43 t $ha^{-1}$) yield was recorded from $S_0$. The findings were corroborated by Klaas (2000) and Yadav *et al*. (2010).

**Table 6. Single effect of N, P, K and S on the yield of strawberry**

| Nutrient levels (kg/ha) | Fruit yield (t $ha^{-1}$) | | | | % yield increase over control | | | |
|---|---|---|---|---|---|---|---|---|
| | **2010** | **2011** | **2012** | **mean** | **2009-10** | **2010-11** | **2011-12** | **mean** |
| **N level** | | | | | | | | |
| 0 | 9.49 | 5.90 | 5.95 | 7.11 | - | - | - | - |
| 90 | 11.31 | 8.15 | 8.10 | 9.19 | 19 | 38 | 36 | 31 |
| 115 | 11.71 | 8.55 | 8.50 | **9.59** | 23 | 45 | 43 | **37** |
| 140 | 11.36 | 8.35 | 8.32 | 9.34 | 20 | 42 | 40 | 34 |
| **P level** | | | | | | | | |
| 0 | 8.67 | 6.18 | 6.15 | 7.00 | - | - | - | - |
| 20 | 10.19 | 7.12 | 7.15 | 8.15 | 17 | 15 | 16 | 16 |
| 40 | 11.71 | 8.55 | 8.50 | **9.59** | 35 | 38 | 38 | **37** |
| 60 | 10.51 | 7.45 | 7.48 | 8.48 | 21 | 21 | 22 | 21 |
| **K level** | | | | | | | | |
| 0 | 7.92 | 6.35 | 6.38 | 6.88 | - | - | - | - |
| 85 | 9.47 | 6.88 | 6.90 | 7.75 | 19 | 8 | 8 | 12 |
| 110 | 11.71 | 8.55 | 8.50 | **9.59** | 47 | 35 | 33 | **38** |
| 135 | 11.09 | 7.95 | 7.92 | 8.99 | 40 | 25 | 24 | 30 |
| **S level** | | | | | | | | |
| 0 | 9.09 | 6.59 | 6.62 | 7.43 | - | - | - | - |
| 15 | 11.07 | 7.65 | 7.68 | 8.80 | 21 | 16 | 16 | 18 |
| 25 | 11.71 | 8.55 | 8.50 | **9.59** | 28 | 30 | 28 | **29** |
| 35 | 10.40 | 7.22 | 7.25 | 8.29 | 14 | 10 | 10 | 11 |

## Conclusion

The combination of $N_{115}P_{40}K_{110}S_{25}$ with blanket dose of $Zn_{4.0}B_{2.0}$ kg $ha^{-1}$ and 10 t $ha^{-1}$ cowdung gave higher yield of strawberry. Thus, combined application of N, P, K and S at 115, 40, 110 and 25 kg $ha^{-1}$ can be recommended for yield maximization of strawberry in terrace soil of Madhupur Tract (AEZ 28).

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