and beet pulp can also be used as cattle feed. It has great nutritive value. Each 100 g sugar beet contains 42.68 g calories, 8 g carbohydrates, 2 g fiber and 1 g protein (Song *et al.*, 2010).

Bangladesh has immense potentiality for sugar beet cultivation which can take the production of sugar to a satisfactory level and farmers should be accustomed to the potentiality for wide-ranging expansion of the farming. The existing sugar mills of Bangladesh can easily extract white sugar from the sugar beet in diffusion method. The diffuser plant and some other related instruments have to be added in the sugar mills for the purpose. Sugarcane could be promisingly introduced as the best replacement of sugarcane all over Bangladesh.

Variety plays an important role on the performance of tropical sugar beet (TSB). Varietals performance differs due to various genetic make-up of varieties/lines. Varietals performance of sugar beet was reported elsewhere (Hossain *et al.*, (2011); Rahman *et al.*, (2006); BSRI (2011); BRAC (2010); Refay (2010); Nenadic *et al.*,(2003); Fortune *et al.*, (1999) and Amin *et al.*, (1989). Fertilize has a remarkable influence on its growth, yield and sugar recovery. Optimum dose of N fertilizer produced maximum root yield and best root quality (Seadh *et al.*, 2013; Abdel-Motagally and Attia, 2009; Leilah *et al.*,2005 and Shalaby *et al.*, 2003). P fertilizer has a great role to increase beet yield with N fertilizer (Ramadan *et al.* 2003). K fertilizer is also important for photosynthesis and to increase the beet and sugar yield (Abdel-Motagally and Attia 2009; EL-Hawary 1999). Studies on determining appropriate fertilizer dose under different soil conditions of Bangladesh is very limited. Therefore, the study was undertaken to find out the suitable variety/line and appropriate NPK fertilizer rate for maximum yield of tropical sugar beet.

## MATERIALS AND METHODS

The experiment was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during the period from November, 2012 to April, 2013. The experimental field was medium high land belonging to non-calcareous dark grey flood plain soil under the AEZ-9 (BARC, 1997). The soil was silts loam in texture having pH 6.8. The experiment consisted of three varieties/lines viz. CS 0327, CS 0328, and HI 0473 and four levels of Urea, TSP and MoP fertilizer application viz. 230-80-185, 260-100-225, 290-120-265 and 320-140-305 kg $ha^{-1}$ of Urea, TSP and MoP, respectively. The experiment was laid out in a Randomized Complete Block Design (RCBD) with 3 replications. The size of the unit plot was 5 $m^2$ (2.5 m × 2.0 m). The land was fertilized with four levels of Urea (230, 260, 290 and 320 kg $ha^{-1}$), TSP (80, 100, 120 and 140 kg $ha^{-1}$) and MoP (185, 225, 265 and 305 kg $ha^{-1}$) with Gypsum, Zinc sulphate, Boric acid and cow dung were applied at the rate of 100, 10, 7 and 5000 kg $ha^{-1}$, respectively. Except Urea whole amount of fertilizers were applied as basal dose. Urea was top dressed in three equal splits at 20, 40 and 60 days after sowing (DAS). Some precautions were taken for using Zn and P fertilizer. These fertilizers were applied separately. The seeds were sown in line maintained 50cm x 20cm spacing. Intercultural operations viz. singling/thinning, gap filling, weeding, irrigation and plant protection measures were taken as per requirement.

The harvesting was done at full maturity. Ten plant samples were randomly selected from each plot before harvesting. Each ten samples were separately uprooted from the plots. The dried and dead leaves were removed from the plants and washed into water. The samples were brought to the covered floor. Data on plant characters and yield contributing characters were collected from those ten sample plants. The beet weight of ten randomly selected plants from each plot was measured and finally converted to t $ha^{-1}$. The collected data were compiled and analyzed statistically using the analysis of variance (ANOVA) technique with the help of computer package program MSTAT-C and the mean differences were adjudged by "Duncan's Multiple Range Test" (Gomez and Gomez, 1984).

## RESULTS AND DISCUSSION

### Effect of variety/line

Plant height, Plant weight, leaf length, leaf weight, beet length, beet girth and beet yield were significantly influenced by variety. The highest plant height (61.73 cm), highest plant weight (82.08 t $ha^{-1}$), longest leaf (62.79 cm) and highest leaf weight (26.47 t $ha^{-1}$) were recorded from the variety/line HI 0473 while the intermediate plant height (56.75 cm), plant weight (68.60 t $ha^{-1}$), leaf length (50.25 cm) and leaf weight (23.77 t $ha^{-1}$) were recorded from the variety/line CS 0327. The lowest plant height (51.28 cm), plant weight (55.73 t $ha^{-1}$), shortest leaf (40.06 cm) and lowest leaf weight (14.79 t $ha^{-1}$) were obtained from variety/line CS 0328. The longest beet (19.28 cm) was obtained from the variety/line HI 0473 which was as good as variety/line CS 0327 (18.35 cm) while the shortest beet (15.67 cm) was recorded from line CS 0328. The highest beet girth (29.60 cm) was obtained from the line HI 0473 followed by the line CS 0327 (28.03 cm) and the lowest beet girth (25.42 cm) was measured from the line CS 0328. The highest beet yield (55.61 t $ha^{-1}$) was obtained from the variety/line HI 0473 which was statistically identical to the line CS 0327 (53.80 t $ha^{-1}$) and the lowest beet yield (31.96 t $ha^{-1}$) was recorded from the line CS 0328 (Fig.1). It might be happened due to the genetic variation among the varieties/lines. The supported results were reported elsewhere (Hossain *et al.* 2011; Rahman *et al.* 2006; BARC 2010; Refay 2010 and Nenadic *et al.* 2003). The genotype of those varieties/lines has a significant effect over its phenotypic characters. Vegetative characters, beet length, beet girth and beet weight were highest in variety/line CS 0327 that cumulatively influence the beet yield of this variety/line The cultivation process of TSB has no control over genotype. However, the differences in beet plant characters and yield due to varieties/lines were also reported by Hossain *et al.* (2011).

### Effect of fertilizer application

Plant characters, yield and yield contributing characters of tropical sugar beet were significantly affected by fertilizer application. The results showed that the longest plant (59.87 cm) was measured in $F_3$ (290 kg $ha^{-1}$ Urea, 120 kg $ha^{-1}$ TSP and 265 kg $ha^{-1}$ MoP) followed by $F_4$ (320 kg $ha^{-1}$ Urea, 140 kg $ha^{-1}$ TSP and 305 kg $ha^{-1}$ MoP) plant height was 57.09 cm which was statistically identical to $F_2$ (260 kg $ha^{-1}$ Urea, 100 kg $ha^{-1}$ TSP and 225 kg $ha^{-1}$ MoP) with plant height 55.73 cm. The shortest plant (53.67 cm) was obtained from $F_1$ (230 kg $ha^{-1}$ Urea, 80 kg $ha^{-1}$ TSP and 185 kg $ha^{-1}$ MoP). The highest plant weight (81.94 t $ha^{-1}$) was found in $F_3$ (290 kg $ha^{-1}$ Urea, 120 kg $ha^{-1}$ TSP and 265 kg $ha^{-1}$ MoP) and the lowest one (55.40 t $ha^{-1}$) was found in $F_1$ (230 kg $ha^{-1}$ Urea, 80 kg $ha^{-1}$ TSP and 185 kg $ha^{-1}$ MoP) (Table 2). In $F_2$ (260 kg $ha^{-1}$ Urea, 100 kg $ha^{-1}$ TSP and 225 kg $ha^{-1}$ MoP) and $F_4$ (320 kg $ha^{-1}$ Urea, 140 kg $ha^{-1}$ TSP and 305 kg $ha^{-1}$ MoP), the plant weight were 66.33 t $ha^{-1}$ and 71.53 t $ha^{-1}$ respectively. The longest leaf (61.56 cm) was recorded in $F_3$ (290 kg $ha^{-1}$ Urea, 120 kg $ha^{-1}$ TSP and 265 kg $ha^{-1}$ MoP) and shortest leaf (39.98 cm) in $F_1$ (230 kg $ha^{-1}$ Urea, 80 kg $ha^{-1}$ TSP and 185 kg $ha^{-1}$ MoP). $F_2$ (260 kg $ha^{-1}$ Urea, 100 kg $ha^{-1}$ TSP and 225 kg $ha^{-1}$ MoP) and $F_4$ (320 kg $ha^{-1}$ Urea, 140 kg $ha^{-1}$ TSP and 305 kg $ha^{-1}$ MoP) gave 49.58 cm and 53.02 cm leaf length respectively. The result indicated that the highest value for leaf weight (22.59 t $ha^{-1}$) was observed in $F_3$ (290 kg $ha^{-1}$ Urea, 120 kg $ha^{-1}$ TSP and 265 kg $ha^{-1}$ MoP) which was as good as (22.32 t $ha^{1}$) in F4 (320 kg $ha^{-1}$ Urea, 140 kg $ha^{-1}$ TSP and 305 kg $ha^{-1}$ MoP) and (22.28 t $ha^{-1}$) in $F_2$ (260 kg $ha^{-1}$ Urea, 100 kg $ha^{-1}$ TSP and 225 kg $ha^{-1}$ MoP). The longest beet (20.38 cm) was observed in $F_3$ (290 kg $ha^{-1}$ Urea, 120 kg $ha^{-1}$ TSP and 265 kg $ha^{-1}$ MoP) and the shortest beet (15.42 cm) in $F_1$ (230 kg $ha^{-1}$ Urea, 80 kg $ha^{-1}$ TSP and 185 kg $ha^{-1}$ MoP). Rest $F_2$ (260 kg $ha^{-1}$ Urea, 100 kg $ha^{-1}$ TSP and 225 kg $ha^{-1}$ MoP) and $F_4$ (320 kg $ha^{-1}$ Urea, 140 kg $ha^{-1}$ TSP and 305 kg $ha^{-1}$ MoP) gave 16.76 cm and 18.51 cm long beet respectively. The highest value for beet girth (30.04 cm) was obtained in $F_3$ (290 kg $ha^{-1}$ Urea, 120 kg $ha^{-1}$ TSP and 265 kg $ha^{-1}$ MoP) and the lowest beet girth (25.16 cm) in $F_1$ (230 kg $ha^{-1}$ Urea, 80 kg $ha^{-1}$ TSP and 185 kg $ha^{-1}$ MoP). In $F_2$ (260 kg $ha^{-1}$ Urea, 100 kg $ha^{-1}$ TSP and 225 kg $ha^{-1}$ MoP) and $F_4$ (320 kg $ha^{-1}$

Urea, 140 kg $ha^{-1}$ TSP and 305 kg $ha^{-1}$ MoP) beet girth were 26.96 cm and 28.58 cm respectively.

The results indicate that the highest beet weight (59.35 t $ha^{-1}$) was recorded in $F_3$ (290 kg $ha^{-1}$ Urea, 120 kg $ha^{-1}$ TSP and 265 kg $ha^{-1}$ MoP) and the lowest beet weight (35.89 t $ha^{-1}$) in $F_1$ (230 kg $ha^{-1}$ Urea, 80 kg $ha^{-1}$ TSP and 185 kg $ha^{-1}$ MoP) (Fig. 2). In the $F_2$(260 kg $ha^{-1}$ Urea, 100 kg $ha^{-1}$ TSP and 225 kg $ha^{-1}$ MoP) and $F_4$ (320 kg $ha^{-1}$ Urea, 140 kg $ha^{-1}$ TSP and 305 kg $ha^{-1}$ MoP) beet weight were 44.05 t $ha^{-1}$ and 49.21 t $ha^{-1}$ respectively. The results of the present study showed that the increasing fertilizer levels up to 290 kg Urea, 120 kg TSP and 265 kg MoP/ha gave the highest value for all plant characters and yield. But further application of N, P and K fertilizer gave the lower value for yield and plant characters. The soil of experimental field might be contains poor quantity of organic matter. Low level of fertilizer application could not be able to provide the optimum nutrient to sugar beet. On the other side, the over fertilizer doses significantly affected the plant characters and yield of sugar beet and produced lower yield. This finding was in agreement with Badawi (1996), El-Moursy *et al.* (1998), Zeinab *et al.* (2000) and Ramadan, 1997. Therefore, the fertilizer treatment $F_3$ (290 kg $ha^{-1}$ Urea, 120 kg $ha^{-1}$ TSP and 265 kg $ha^{-1}$ MoP) was the optimum dose for tested TSB variety/line.

**Interaction effect of varieties/ lines and fertilizer application**

The interaction between varieties/lines and fertilizer application had significant influence on plant height, plant weight, leaf length, leaf weight, beet length, beet girth and beet yield. The tallest plant (67.47 cm) was obtained from the line HI 0473 with $F_3$ (290 kg $ha^{-1}$ Urea, 120 kg $ha^{-1}$ TSP and 265 kg $ha^{-1}$ MoP) treatment and the shortest plant (48.87 cm) from the line CS 0328 with $F_1$ (230 kg $ha^{-1}$ Urea, 80 kg $ha^{-1}$ TSP and 185 kg $ha^{-1}$ MoP) treatment (Table 3). The highest plant weight (99.76 t $ha^{-1}$) was observed from the line HI 0473 with the $F_3$ (290 kg $ha^{-1}$ Urea, 120 kg $ha^{-1}$ TSP and 265 kg $ha^{-1}$ MoP) treatment and the lowest plant weight (48.60 t $ha^{-1}$) was observed from the line CS 0328 with $F_1$ (230 kg $ha^{-1}$ Urea, 80 kg $ha^{-1}$ TSP and 185 kg $ha^{-1}$ MoP) treatment (Table 3). Numerically the longest leaf (76.96 cm) was obtained from the line HI 0473 with $F_3$ (290 kg $ha^{-1}$ Urea, 120 kg $ha^{-1}$ TSP and 265 kg $ha^{-1}$ MoP) treatment and the shortest leaf (35.40 cm) was observed from the line CS 0328 with $F_1$ (230 kg $ha^{-1}$ Urea, 80 kg $ha^{-1}$ TSP and 185 kg $ha^{-1}$ MoP) treatment (Table 3). The highest leaf weight (28.40 t $ha^{-1}$) was recorded in the line HI 0473 with $F_2$ (260 kg $ha^{-1}$ Urea, 100 kg $ha^{-1}$ TSP and 225 kg $ha^{-1}$ MoP) and $F_4$ (320 kg $ha^{-1}$ Urea, 140 kg $ha^{-1}$ TSP and 305 kg $ha^{-1}$ MoP) treatments and the lowest leaf weight (12.78 t $ha^{-1}$) was observed in the line CS 0328 with $F_3$ (290 kg $ha^{-1}$ Urea, 120 kg $ha^{-1}$ TSP and 265 kg $ha^{-1}$ MoP) treatment (Table 1). The longest beet (22.80 cm) was observed in the interaction between line HI 0473 and $F_3$ (290 kg $ha^{-1}$ Urea, 120 kg $ha^{-1}$ TSP and 265 kg $ha^{-1}$ MoP) treatment. The shortest beet (13.20 cm) was measured in the line CS 0328 with the $F_1$ (230 kg $ha^{-1}$ Urea, 80 kg $ha^{-1}$ TSP and 185 kg $ha^{-1}$ MoP) treatment (Table 3). The highest beet girth (31.93 cm) was found in the line HI 0473 with $F_3$ (290 kg $ha^{-1}$ Urea, 120 kg $ha^{-1}$ TSP and 265 kg $ha^{-1}$ MoP) treatment and the lowest beet girth (22.33 cm) was recorded in the line CS 0328 with $F_1$ (230 kg $ha^{-1}$ Urea, 80 kg $ha^{-1}$ TSP and 185 kg $ha^{-1}$ MoP) treatment (Table 3).

The highest beet yield (72.17 t $ha^{-1}$) was found in the line HI 0473 with $F_3$ (290 kg $ha^{-1}$ Urea, 120 kg $ha^{-1}$ TSP and 265 kg $ha^{-1}$ MoP) which was as good as beet yield (68.33 t $ha^{-1}$) from the line CS 0327 with $F_2$ (260 kg $ha^{-1}$ Urea, 100 kg $ha^{-1}$ TSP and 225 kg $ha^{-1}$ MoP) and the lowest beet yield (26.33 t $ha^{-1}$) was recorded in the line CS 0328 with $F_1$ (230 kg $ha^{-1}$ Urea, 80 kg $ha^{-1}$ TSP and 185 kg $ha^{-1}$ MoP) treatment (Table 3).

**Relationship between plant characters and beet yield**

Relationship between beet yield and different plant characters have been shown in Fig. 3, Fig. 4 and Fig. 5. Beet yield found to be linearly correlated with plant characters viz. plant height ($r = 0.884$) (Fig. 3), beet length ($r = 0.938$) (Fig. 4) and beet girth ($r = 0.901$) (Fig. 5). Similar type of results was reported by Hossain *et al.* (2011). The optimum dose of

NPK fertilizer increased the size and number of leaves, which led to increasing leaf area and photosynthetic activities. The higher dry matter might be accumulated in the root due to increasing photosynthesis that leads to higher beet yield. Thus, the beet yield significantly increased with increasing of plant height, beet length and beet girth. Based on the results it may be concluded that HI 0473 appears as the best variety/ line of tropical sugar beet among the tested varieties/ lines and it should be fertilized at the rate of 290 kg $ha^{-1}$ Urea and 120 kg $ha^{-1}$ TSP and 265 kg $ha^{-1}$ $M_oP$ with 100 kg, 10 kg, 7 kg and 5000 kg $ha^{-1}$ Gypsum, Zinc Sulphate, Boric Acid and Cow dung, respectively.

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**Table-1 Effects of variety on plant characters and yield of tropical sugar beet**

| Variety | Plant height (cm) | Plant weight (t ha$^{-1}$) | Leaf length (cm) | Leaf weight (t ha$^{-1}$) | Beet length (cm) | Beet girth (cm) |
|---|---|---|---|---|---|---|
| $V_1$ | 56.75b | 68.60b | 50.25b | 23.77b | 18.35a | 28.0 b |
| $V_2$ | 51.28c | 55.73c | 40.06c | 14.79c | 15.67b | 25.42c |
| $V_3$ | 61.73a | 82.08a | 62.79a | 26.47a | 19.28a | 29.60a |
| Level of significance | ** | ** | ** | ** | ** | ** |
| Sx | 0.586 | 1.51 | 0.810 | 0.807 | 0.962 | 0.416 |

In a column, figure with same letters do not differs significantly whereas figure with dissimilar letters differ significantly as per DMRT level.
$V_1$ = CS 0327 $V_2$ = CS 0328 $V_3$ = HI 0473 ** = Significant at 1% level

**Table-2 Effects of fertilizer dose on plant characters and yield of tropical sugar beet**

| Fertilizer doses | Plant height (cm) | Plant weight (t ha$^{-1}$) | Leaf length (cm) | Leaf weight (t ha$^{-1}$) | Beet length (cm) | Beet girth (cm) |
|---|---|---|---|---|---|---|
| $F_1$ | 53.67c | 55.40d | 39.98d | 19.51b | 15.42d | 25.16d |
| $F_2$ | 55.73b | 66.33c | 49.58c | 22.28a | 16.76c | 26.96c |
| $F_3$ | 59.87a | 81.94a | 61.56a | 22.59a | 20.38a | 30.04a |
| $F_4$ | 57.09b | 71.53b | 53.02b | 22.32a | 18.51b | 28.58b |
| Level of significance | ** | ** | ** | ** | ** | ** |
| Sx | 0.582 | 1.01 | 0.890 | 0.701 | 0.228 | 0.236 |

In a column, figure with same letters do not differs significantly whereas figure with dissimilar letters differ significantly as per DMRT level.
$F_1$ = 230 kg ha$^{-1}$ Urea, 80 kg ha$^{-1}$ TSP and 185 kg ha$^{-1}$ MoP $F_2$ =260 kg ha$^{-1}$ Urea, 100 kg ha$^{-1}$ TSP and 225 kg ha$^{-1}$ MoP
$F_3$ =290 kg ha$^{-1}$ Urea, 120 kg ha$^{-1}$ TSP and 265 kg ha$^{-1}$ MoP $F_4$ =320 kg ha$^{-1}$ Urea, 140 kg ha$^{-1}$ TSP and 305 kg ha$^{-1}$ MoP
** = Significant at 1% level

**Table-3 Interaction effects of variety/line and fertilizer dose on plant characters and yield of tropical sugar beet**

| Variety/line x Fertilizer doses | Plant height (cm) | Plant weight (t ha$^{-1}$) | Leaf length (cm) | Leaf weight (t ha$^{-1}$) | Beet length (cm) | Beet girth (cm) | Beet yield (t ha$^{-1}$) |
|---|---|---|---|---|---|---|---|
| $V_1 \times F_1$ | 55.27de | 56.40ef | 39.67f | 22.27b | 16.73d | 26.13d | 41.60 d |
| $V_1 \times F_2$ | 56.80de | 64.01d | 46.95d | 22.42b | 17.07cd | 26.73d | 47.98c |
| $V_1 \times F_3$ | 58.00cd | 81.11b | 60.78b | 27.39a | 20.33b | 29.73bc | 68.33a |
| $V_1 \times F_4$ | 56.93de | 72.86c | 53.59c | 23.00b | 19.27b | 29.53bc | 57.30b |
| $V_2 \times F_1$ | 48.87h | 48.60g | 35.40f | 14.80c | 13.20f | 22.33f | 26.33g |
| $V_2 \times F_2$ | 50.07gh | 52.74fg | 37.61f | 16.03c | 15.13e | 24.80e | 30.32fg |
| $V_2 \times F_3$ | 54.13ef | 64.94d | 46.94d | 12.78c | 18.00c | 28.47c | 37.55de |
| $V_2 \times F_4$ | 52.07fg | 56.63ef | 40.30ef | 15.56c | 16.33de | 26.07d | 33.6ef |
| $V_3 \times F_1$ | 56.87de | 61.20de | 44.87de | 21.47b | 16.33de | 27.00d | 39.73d |
| $V_3 \times F_2$ | 60.33bc | 82.24b | 64.17b | 28.40a | 18.07c | 29.33bc | 53.84b |
| $V_3 \times F_3$ | 67.47a | 99.76a | 76.96a | 27.59a | 22.80a | 31.93a | 72.17a |
| $V_3 \times F_4$ | 62.27b | 85.11b | 65.18b | 28.40a | 19.93b | 30.13b | 56.71b |
| Level of significance | * | ** | ** | ** | * | * | ** |
| Sx | 1.01 | 1.74 | 1.54 | 1.21 | 0.396 | 0.409 | 1.37 |

In a column, figure with same letters do not differs significantly whereas figure with dissimilar letters differ significantly as per DMRT level.
$V_1$ = CS 0327 $V_2$ = CS 0328 $V_3$ = HI 0473

$F_1$ = 230 kg ha$^{-1}$ Urea, 80 kg ha$^{-1}$ TSP and 185 kg ha$^{-1}$ MoP $F_2$ =260 kg ha$^{-1}$ Urea, 100 kg ha$^{-1}$ TSP and 225 kg ha$^{-1}$ MoP
$F_3$ =290 kg ha$^{-1}$ Urea, 120 kg ha$^{-1}$ TSP and 265 kg ha$^{-1}$ MoP $F_4$ =320 kg ha$^{-1}$ Urea, 140 kg ha$^{-1}$ TSP and 305 kg ha$^{-1}$ MoP
* = Significant at 5% level ** = Significant at 1% level

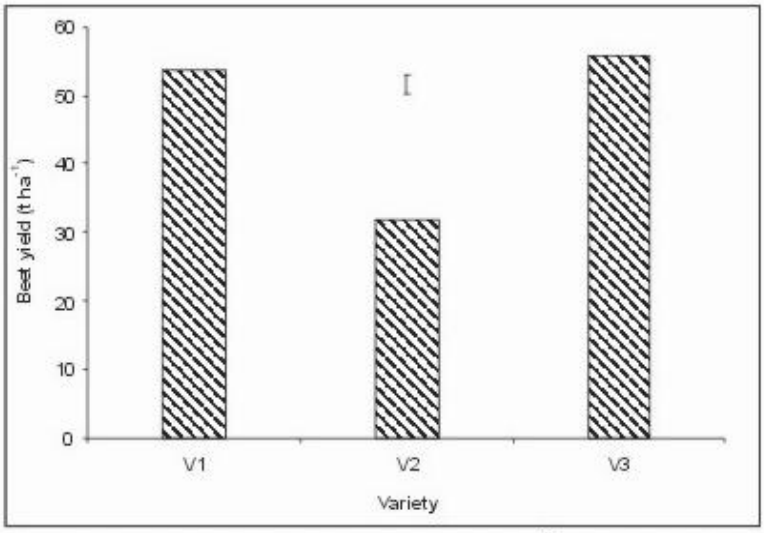


**Fig. 1 Effect of variety/line on beet yield (t ha$^{-1}$) of tropical sugar beet**

$V_1$ = CS 0327 $V_2$ = CS 0328 $V_3$ = HI 0473

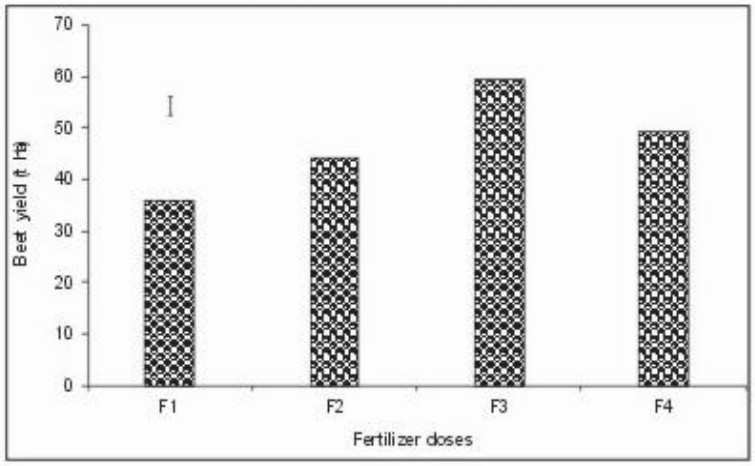


**Fig.2 Effect of fertilizer doses on beet yield (t ha$^{-1}$) of tropical sugar beet**

$F_1$ = 230 kg ha$^{-1}$ Urea, 80 kg ha$^{-1}$ TSP and 185 kg ha$^{-1}$ MoP $F_2$ =260 kg ha$^{-1}$ Urea, 100 kg ha$^{-1}$ TSP and 225 kg ha$^{-1}$ MoP

$F_3$ =290 kg ha$^{-1}$ Urea, 120 kg ha$^{-1}$ TSP and 265 kg ha$^{-1}$ MoP $F_4$ =320 kg ha$^{-1}$ Urea, 140 kg ha$^{-1}$ TSP and 305 kg ha$^{-1}$ MoP

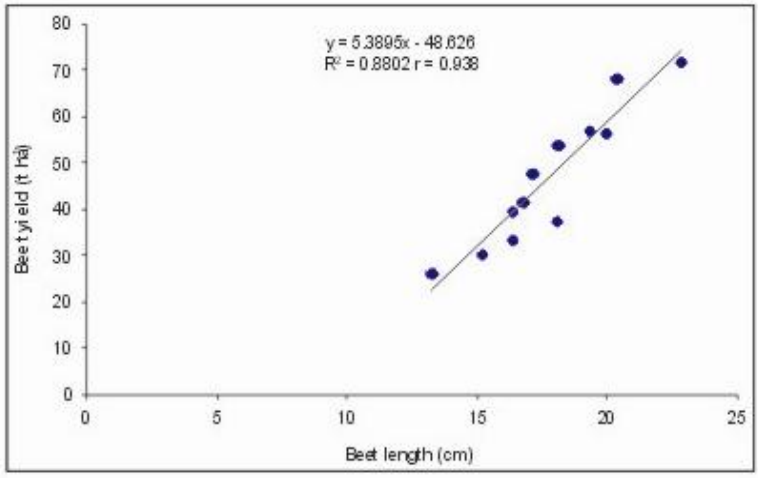


**Fig.3 Relationship between plant height (cm) and beet yield (t ha$^{-1}$) of tropical sugar beet**

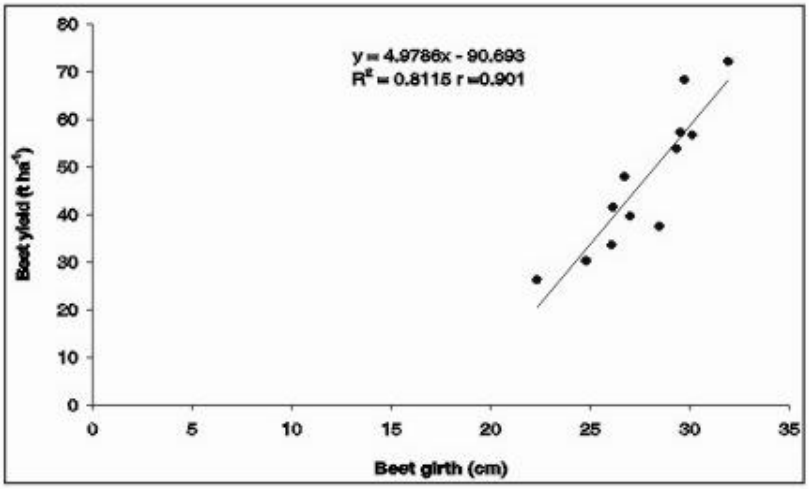


**Fig.4 Relationship between beet length (cm) and beet yield (t ha$^{-1}$) of tropical sugar beet**

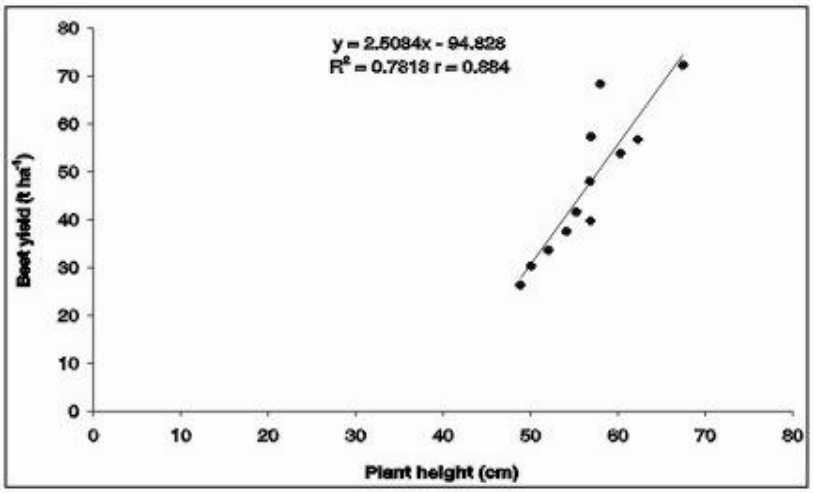


**Fig.5 Relationship between beet girth (cm) and beet yield (t ha$^{-1}$) of tropical sugar beet**