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# QUANTITATIVE AND QUALITATIVE PARAMETERS OF SUGARCANE VARIETY HOTH-300 AS AFFECTED BY DIFFERENT LEVELS OF NPK APPLICATIONS

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## ABSTRACT

During 2006-07, the field experiment was conducted at NSCRI, Thatta to observe the effect of different levels of nitrogen; phosphorus and potassium applications on the yield and quality of sugarcane variety HoTh-300. In this study fertilizer levels of 80 and 160 kg ha$^{-1}$ $P_2O_5$ and $K_2O$, were tested in combination with 200 kg ha$^{-1}$ nitrogen. The experiment was laid out according to Completely Randomized Design (CRD) with three replications and nine treatments. Significant differences for cane yield and yield contributing traits were observed among the treatments. Highest average cane yield of 123 t ha$^{-1}$was recorded in T 9 which was followed by 121, 120 and 113 t ha$^{-1}$ average cane yield in T8, T6 and T5, respectively. Moreover, the plots receiving T7, T4, T3 and T2 displayed average cane yield of 100, 98, 95 and 93 t ha$^{-1}$, respectively. However, the lowest average cane yield of 86 t ha$^{-1}$ was recorded from T1 (control). As regards the cost benefit ratio, it was observed that fertilizer dose @ 200+80+80 kg N+$P_2O_5$+$K_2O$ ha$^{-1}$ was suitable fertilizer treatment for obtaining maximum cane and sugar yield in genotype HoTh-300.

**Key words:** Sugarcane, NPK nutrients, Fertilizers levels, Yield parameters, Yield, CCS%, Sugar yield and Cost benefit ratio.

## INTRODUCTION

Sugarcane (*Saccharum officinarum,* L.) is the third major crop of Pakistan. It is not only an important sugar crop but also a source of raw material for various agro-based industries in Pakistan. The national average cane yield (49.00 t ha$^{-1}$) and sugar recovery (9.46%) is much lower than the other sugarcane growing countries of the world (Arain *et al.,* 2011, Junejo *et al.,* 2010 & PSMA, 2009). The average cane yield and sugar recovery in Pakistan however, is much lower than the achievable potential of our existing sugarcane varieties (Ayoub *et al.,* 1999). Sugarcane is annual exhaustive crop and requires large amount of nutrients during its different stages of growth. Yadava (1993) stated that being a long duration crop 125 t ha$^{-1}$ of sugarcane removes 83 kg N, 37 kg $P_2O_5$ and 168 kg $K_2O_5$. Isherwood (2006) estimated that less than two percent of the farmers apply potash whereas 92 percent apply nitrogen and 83 percent apply phosphate. The cane height, number of tillers, millable cane stalks, yield of cane and sugar increased progressively with application of NPK (Gurmani *et al.,* 2003, Bokhtiar *et al.,* 2002, Iqbal *et al.,* 2002, Khan *et al.,* 2002, Chaudhery and Chattha 2000 and Nasir *et al.,* 1994). Although the biological potential of a high yielding variety is inherent in its seed, yet to explore it under field conditions, a proper package of inputs and cultural practices has to be adopted in a specific agro-ecological condition. In this package, balanced use of fertilizer is of paramount importance. Increased cropping intensity and the evolution of high yielding varieties has made the fertilizer use indispensable. Therefore, it is imperative to supplement required plant nutrients at proper time, in proper amounts and balanced proportions to harvest the maximum potential of the existing sugarcane varieties. The present study was therefore, planned to evaluate the effect of NPK applications on the yield and quality of HoTh-300 sugarcane genotype and also to determine optimum NPK level for getting maximum economic returns from the same genotype under agro-climatic conditions of Thatta.

## MATERIALS AND METHODS

During 2006-07, the experiment was conducted at NSCRI, farm, Thatta to observe the effect of different levels of nitrogen; phosphorus and potassium on the yield and quality of sugarcane variety HoTh-300. In this study fertilizer dose of 80 and 160 kg ha$^{-1}$ $P_2O_5$ and $K_2O$, respectively were tested in combination with 200 kg ha$^{-1}$ nitrogen. The treatments included were as

T1-200+0+0N+$P_2O_5$+$K_2O$ kg ha$^{-1}$ (control)
T 2- 200+0+80 N+$P_2O_5$+$K_2O$ kg ha$^{-1}$
T 3- 200+0+160 N+$P_2O_5$+$K_2O$ kg ha$^{-1}$
T 4- 200+80+0 N+$P_2O_5$+$K_2O$ kg ha$^{-1}$
T 5- 200+80+80 N+$P_2O_5$+$K_2O$ kg ha$^{-1}$
T 6- 200+80+160 N+$P_2O_5$+$K_2O$ kg ha$^{-1}$
T 7- 200+160+0 N+$P_2O_5$+$K_2O$ kg ha$^{-1}$
T 8- 200+160+80 N+$P_2O_5$+$K_2O$ kg ha$^{-1}$
T 9- 200+160+160 N+$P_2O_5$+$K_2O$ kg ha$^{-1}$

The experiment was laid out according to Completely Randomized Design (CRD) with three replications having whole plot size of 1262 m$^2$. Each treatment had 7.5 meter long three rows at 1.25 meters row to row distance. Three budded cane sets were sown in 9 inch deep furrows, than the sets were buried with thin layer of soil. The NPK were applied in the form of Urea, Di-Ammonium Phosphate (DAP) and Murate of Potash (MOP) as per treatment schedule. All cultural practices, insect pest and disease control measures were followed uniformly in all the treatments. On maturity three rows from each plot were harvested to record data on cane yield and yield components. Five canes selected randomly from the each plot were utilized for record of commercial cane sugar percentage (CCS%) as suggested by Meade and Chen (1977). The data were collected for cane thickness, number of internodes per cane, cane height, number of millable canes, cane yield, commercial cane sugar (CCS%) and sugar yield. The data was analyzed statistically using ANOVA and simple quadratic regression through MSTATC, microcomputer statistical programe (1992). The relative role of P and K was calculated as suggested by Gurmani *et al*. (2003) and cost benefit ratio was calculated according to Tan don and Roy (2004).

Before sowing a composite soil sample was taken and analyzed for the physico-chemical properties at soil and water testing laboratory, NSCRI, PARC, Thatta. Soil was heavy in texture, strongly alkaline, slightly saline and poor in organic matter. The N and P content were low while, K was adequate (Table-1).

**Table-1 Physicochemical status of the experimental plot at NSCRI, Thatta.**

| Soil Depth (cm) | Soil Texture | | | Textural Class | pH (1:5) | ECe ($dSm^{-1}$) | OM (%) | N (%) | P ($mgkg^{-1}$) | K ($mgkg^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|
| | Clay (%) | Sand (%) | Silt (% ) | | | | | | | |
| 0-15 | 45.65 | 39.35 | 15.0 | Clay | 8.85 | 2.40 | 0.82 | 0.041 | 3.50 | 160 |
| 15-45 | 46.90 | 35.60 | 17.5 | Clay | 8.80 | 2.80 | 0.20 | 0.01 | 1.75 | 105 |

## RESULTS AND DISCUSSION

The treatments difference were non significant for cane thickness. The perusal of data for cane thickness in Table-2 revealed that maximum average cane thickness (24.47 mm) was recorded in T9, followed by T5 (24.35 mm) while, T4 and T7 remained statistically on par with average cane thickness of 24.24 mm. In contrast, minimum average cane thickness (23.88 mm) was observed in T1 (control). However, in rest of the treatments no prominent differences for cane thickness were exhibited.

As regards the number of internodes $plant^{-1}$, the treatment differences were highly significant (>0.01). The data in Table-2 further revealed that maximum 30.00 internodes $plant^{-1}$ were recorded in T3, followed by T9 with 29.66 internodes per plant. However, T1, T2, T7 and T8 remained at par with 27.66, 26.66, 25.66 and 25.66 internodes $plant^{-1}$, respectively. In contrast, the lowest 22.66 and 23.66 internodes $plant^{-1}$ were observed in T4 and T6, respectively.

In case of cane height highly significant differences (>0.01) were observed among the treatments. Statistically highest average cane height (251.66 cm) was measured in T9. However, rest of the treatments like T5, T8, T3, T7, T6, T4 and T2 remained statistically at par with the average cane height of 238.55, 226.33, 217.33, 211.00, 210.33, 207.66 and 200.10 cm, respectively. In contrast, statistically lowest average cane height (189.44 cm) was recorded in T 1 (Table-2).

There were highly significant differences (> 0.01) among the treatments for millable canes. The data in Table-2 indicated that the T8 and T9 remained statistically superior with maximum 108333 and 101666 millable canes $ha^{-1}$, respectively. While, in T5, T6 and T7 statistically matching results were exhibited with 98333, 96666 and 96666 millable canes $ha^{-1}$, respectively. On the contrary, in rest of the treatments like T4, T2 and T1 statistically lowest millable canes $ha^{-1}$ were obtained.

Junejo *et al.* (2010) reported that cane girth, cane height cane internode and millable canes are most important yield contributing parameters. Majidano *et al*. (2003) and Mehboob *et al*. (2000) stated that significantly maximum cane thickness, cane height, cane internode and number of millable canes $ha^{-1}$ were obtained with the balanced NPK application.

The cane thickness, cane height, millable cane stalks increased progressively with application of NPK at 200-80-160 kg $ha^{-1}$ (Bokhtiar *et al.,* 2002). Ali *et al.* (2000) concluded that significantly maximum cane thickness, cane height cane internode and millable canes $ha^{-1}$ were obtained with application of NPK at 200-200-100 kg $ha^{-1}$.

The statistical analysis of the data for average cane yield showed that there were highly significant (> 0.01) differences among the treatments. The perusal of data in Table-2 further revealed that statistically highest average cane yield of 123 t $ha^{-1}$ was exhibited in T9 which was followed by T8, T6 and T5 with statistically almost equivalent average cane yield of 121, 120, 113 t $ha^{-1}$, respectively. Moreover, in T4, T3 and T2 exhibited statistically identical results with average cane yield of 98, 95 and 93 t $ha^{-1}$, respectively. Contrary to this, in control (T1) statistically lowest average cane yield of 86 t $ha^{-1}$ was recorded. It was observed that each increment in nutrients level with balance fertilization tended to increase the cane yield significantly. This may be attributed to role of Thatta-300 sugarcane genotype for utilizing efficiently the required nutrients under given set of soil and environmental conditions. Khan *et al.* (2005), Gurmani *et al*. (2003), Iqbal *et al.* (2002) and Chaudhry and Chatta (2000) reported that the sugarcane yield started increasing with increase in balanced nutrients levels. Similarly, Yadava (1993) stated that being a long duration crop an adequate and balanced supply of all these nutrients is required for obtaining sustainable crop yield. Maximum cane yield of 146.60 t $ha^{-1}$ was recorded from the plot having NPK applied at 100-100-50 kg $ha^{-1}$ (Nasir *et al.,* 1994). Fertilizer application of 200-150-150 kg NPK $ha^{-1}$ was found to be the optimum level for achieving maximum cane yield from the sugarcane varieties (Iqbal *et al.,* 2002 & Ayoub *et al.,* 1999).

The correlation coefficient values for $P_2O_5$ (r = 0.62) and $K_2O$ (r = 0.53) were highly significant and positively associated with cane yield. Coefficient of determination ($r^2$) values were 38% and 28% for $P_2O_5$ and $K_2O$, respectively, which showed strong relationship with cane yield that have been described by equation from Y =92.59+0.20x and Y= 94.25+0.18x for $P_2O_5$ and $K_2O$, respectively.

As regards the commercial cane sugar percentage there were non-significant differences among the treatments for this trait. However, maximum CCS of 14.54% was obtained in T6, while, the lowest CCS of 12.34% was recorded in T1 (control). Moreover, in rest of the treatments no prominent differences for this trait were observed.

In case of sugar yield highly significant (>0.01) differences among the treatments were observed. The data in Table-2 indicated that in T6 exhibited statistically highest average sugar yield of 17.44 t $ha^{-1}$ followed by T9, T8 and T5 with statistically at par average sugar yield of 16.62, 16.26 and 15.28%, respectively. Moreover, in T3, T4 and T7 showed moderate results with average sugar yield of 13.20, 13.14 and 13.0%, respectively. In contrast, minimum sugar yield of 10.60 t $ha^{-1}$ was exhibited in control (T1). The previous studies carried out by El-Sayed *et al*. (2005) and Ali *et al*. (2000) revealed that sugar yield differed significantly at varied level of NPK. Gurmani *et al.* (2003) reported that NPK dose of 150-80-80 kg $ha^{-1}$ is the most optimum level for better cane and quality production of sugarcane.

Cost benefit ratio in Table-2 indicated that the highest net profit return (1:0.54) was earned from T6 followed by T5 (1:0.53), T8 (1:0.52), T9 (1:0.50) and T4 (1:0.45). However, from T2 and T7 similar net profit return (1:0.44) was obtained. While, fairly better net profit return (1:0.40) was obtained from T3. The lowest net profit return 1:0.36 was earned from T1 (control). All the fertilizers levels were found highly profitable over the control. This trend of data indicates that the use of fertilizer in balanced amount will always remain profitable for the sugarcane growers. The existing profitability levels can considerably be improved with the use of NPK fertilizers in balanced amount. The results are in accordance with Khan *et al.* (2005) and Gurmani *et al.* (2003).

**Table-2. Effect of NPK fertilizers on yield contributing parameters, cane yield CCS%, sugar yield and cost benefit ratio at NSCRI, Thatta.**

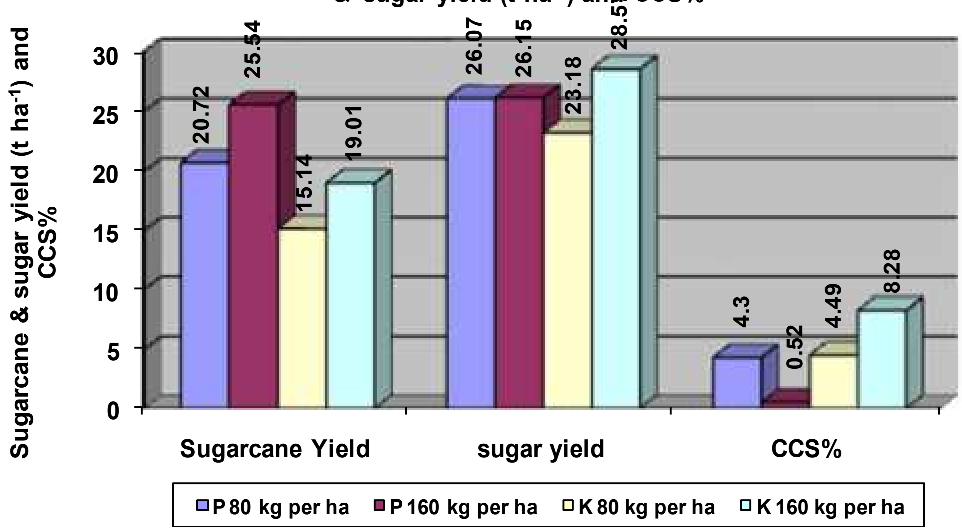
| Treatments | Cane Girth (mm) | Cane Height (cm) | No. Inter node $Plant^{-1}$ | Millable Canes ($ha^{-1}$) | Cane Yield ($tha^{-1}$) | CCS % | Sugar Yield | CBR |
|---|---|---|---|---|---|---|---|---|
| T1 | 23.88a | 189.44d | 27.66abc | 80000c | 86.00c | 12.34a | 10.61c | 1:0.36 |
| T2 | 23.90a | 200.10abc | 26.66abc | 81666c | 93.00cd | 13.51ab | 12.56bc | 1:0.44 |
| T3 | 24.10a | 217.33ab | 30.00a | 81666c | 95.00cd | 13.90ab | 13.20abc | 1:0.40 |
| T4 | 24.03a | 207.66abc | 22.66c | 83333c | 98.00bcd | 13.41ab | 13.14abc | 1:0.45 |
| T5 | 24.24a | 238.55ab | 25.00bc | 98333b | 113.00abc | 13.53ab | 15.28ab | 1:0.53 |
| T6 | 24.24a | 210.66abc | 23.66c | 96666b | 120.00abc | 14.54a | 17.44a | 1:0.54 |
| T7 | 24.06a | 211.00abc | 25.66abc | 96666b | 100.00abcd | 13.00ab | 13.00bc | 1:0.44 |
| T8 | 24.35a | 226.33ab | 25.66abc | 108333a | 121.00ab | 13.44ab | 16.26ab | 1:0.52 |
| T9 | 24.47a | 251.66a | 29.66ab | 101666a | 123.00a | 13.52ab | 16.62ab | 1:0.50 |
| CV% | 6.62 | 9.01 | 9.06 | 13.85 | 8.36 | 7.10 | 14.17 | |
| LSD 5% | NS | 32.00 | 3.99 | 6878.0 | 14.79 | NS | 3.51 | |
| LSD 1% | | 44.35 | 5.40 | 9298.0 | 19.99 | | 4.75 | |
| SE | | 4.44 | 0.59 | 4356.58 | 3.30 | | 0.53 | |

Note: Means followed by the same letters do not differ significantly at 5 and 1 %level of probability.
Least significant differences (LSD) Test: CBR = Cost benefit ratio, CV = Coefficient of covariance, SE= Standard error.

Splitting of data in to a respective factor of P and K shows (Figure-1) that with the application of 80 and 160 kg $P_2O_5$ $ha^{-1}$, the cane yield increased by 20.72 and 25.54%, respectively over control. Similarly, K attributed 15.14 and 19.01% increase over control. The results showed that P has dominant role over K in increasing sugarcane yield t $ha^{-1}$. The smaller response of K may be due to adequate potash level in soil. In case of sugar yield t $ha^{-1}$ P increased 26.07 and 26.15% over control at both the P levels, while K attributed 23.18 and 28.57 %, respectively. The results indicated that P fertilization played same role in increasing of sugar yield at both levels while K attributed more sugar yield than P at high level. Further analysis of data reveals that both P and K played a dominant role in CCS% and sugar yield t $ha^{-1}$. P increased 4.30 and 0.52%.of CCS% over control at 80 and 160 kg $P_2O_5$ $ha^{-1}$, respectively. While K attributed 4.49 to 8.28% of CCS% over control at 80 and 160 kg $K_2O$ $ha^{-1}$ which indicates that the K has dominant role over P for increasing the CCS%. The results are with the confirmation of Gurmani *et al.* (2003) and Bokhtiar *et al.* (2002) who reported that P has dominate role over K for increasing of sugarcane yield $tha^{-1}$, while K has dominate role over P in case of sugar%.

It was concluded that balanced NPK levels increased the cane yield $tha^{-1}$ significantly than the imbalanced levels. P has greater role than K increasing of cane yield t $ha^{-1}$, while K has dominate role over P in case of sugar%. Comparatively smaller cost benefit ratio was earned when P was lacking. However, for maximum quality and higher cost benefit ratio K should also be incorporated. The optimum level of fertilizer @ 200+80+80 kg $N+P_2O_5+K_2O$ $ha^{-1}$, was found economical after considering its effect on cane and sugar yield.

**Fig-1: Relative role of P and K levels in percent increase of sugarcane & sugar yield (t ha-1) and CCS%**




## REFERENCES

Ali, F. G. M. A. Iqbal, A. A. Chatta and S. Afghan (2000). Fertilizer use efficiency and cane yield under different nitrogen levels and weed management practices in sprong planted sugarcane. Pakistan Sug. J. 15 (01):22-26.

Arain M. Y. R. N. Panhwar, N. Gujar, M. Chohan, M. A. Rajput, A. F. Soomro and S. Junejo (2011). Evaluation of new candidate sugarcane varieties for some qualitative and quantitative trats under Thatta agro-climatic conditions. The J. Anim. Plant Sci. 21 (2):226-230.

Ayoub, M., R. Ahmed, A. Tanveer, H. Z. Ahmed and M. S. Sharar. (1999). Growth, yield and quality of sugarcane (*Saccharum officinarum* L.) as affected by different levels of NPK applications. Pakistan J. Bio. Sci. 2(1):80-82.

Bokhtiar, S. M., G. C. Pual, A. B. M. Mafizar Rehman and M. M. Alam (2002). Response of NPK and S on the growth and yield of sugarcane grown in the calcareous dark grey flood plain soils of Bangladesh. Sugar J. 17(1):16-21.

Chattha. A. A., F. G. Ali, and G. Ghous. (2000). Strategy for the improvement of sugarcane yield. Workshop Research and development Activities in Pakistan. Sep. 15-16:1-8

Chaudhery, A. U. and F.A. Chatta (2000). Determination of optimum level of phosphorus and its effect on growth yield and quality of ratoon sugarcane. Pakistan .J. Biol. Sci. 3(3):483-484.

El-Sayed, G. S.; A. M. H. Osman and A. M. Ahmed (2005). Effect of nitrogen, phosphorus and potassium fertilization on yield and quality of sugar cane. Egypt. J. Agric. Res., 83 (1): 241-257.

Gurmani, A.H., A. Bakhash, and G. Rasool. (2003). Effect of NPK on yield and sugar level of sugarcane Pakistan. J. Soil Sci. 22 (2): 56-60.

Iqbal, A., Ehsanullah and K. Iqbal (2002). Biomass production and its portioning in sugarcane at different nitrogen and phosphorus application rates. Pakistan. Sugar J. 17(2):4-17.

Isherwood K. (2006). Fertilizer development during the 20th century. Farming out look 5(1):3-10

Junejo S. G. M. Kaloi, R. N. Panhwar. M. Chohan, A. A. Junejo and A. F. Soomro (2010). Performance of newly developed sugarcane genotypes for some qualitative and quanitative traits under Thatta conditions. The J. Plant Anim. Sci. 20 (1): 40-43

Khan, I. A., A. Khatri, M. A. Javed, S. H. Siddiqui, M. Ahmad, N. A. Dahar, M. H. Khanzada and R. Khan (2002). Performance of sugarcane clone AEC81-8415 for yield and quality characters. II Stability studies. Pakistan J. Bot. 34(3):247-251.

Khan, I. A., A. Khatri, G. S. Nizamani, M. A. Siddiqui, S. Raza and N. A. Dahar (2005). Effect of NPK fertilizer on the growth of sugarcane clone AEC86-347 developed at NIA Tandojam, Pakistan. Pakistan .J. Bot. 37(2):355-360.

MSTATC (1991), Micro computer statistical program, Michigan State University, USA.

Majidano, H. I., Y. J. Minhas A. D. Jarwar, S. D. Tunio and H. K. Puno (2003). Effect of potassium levels and method of application on sugarcane yield. Pakistan. Sug. J. 3:17-19.

Meade, C. P. and J. C. P. Chen, (1977). Cane sugar hand book, 10th ed. Jhon Wiley and Sons, Inc. New York. 947p.

Mehboob A., F. G. Ali, M. Saeed and S. Afghan (2000). Effect of moisture regime and fertilizer levels on yield and yield parameters of spring sugarcane. Pakiatan. Sug. J. 15(5):2-6.

Nasir, N. M., M. A. Qureshi and S. Afghan. (1994). Effect of bio-compost on sugarcane crop. Pakistan Sugar J. 8(3):13-16.

PSMA, (2009). Annual report for the year ended September 30, 2011, Pakistan Sugar Mills Association, Sindh Zone, First floor, Modern Motors House, Beaumont road, Karachi. .17p.

Saleem, M. T. (2008). Pakistan fertilizer scenario 2008. Farming outlook 7(3-4):3-7.

Tandon, H. L. S. and R. N. Roy (2004). Integrated nutrients management-A Glossary of terms. Fertilizer Development and consultation organization F.A.O. United Nations: 22

Yadava, R. S. (1993). Agronomy of sugarcane principle and practices. 1st Ed.. NTEK computer System, 87. Rath Khana Moulviganj, Lucknow. .200-201p.