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Effect of Different Fertilizer Doses with Different Combinations on Cotton Growth and Yield

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Abstract
Fertilizers are used to provide the nutrient supply that is necessary to improve crop yield. This study was conducted to observe the effects of different doses and combinations of fertilizers on cotton growth and yield. A field was divided into six areas, each treated with different combinations of four different types of fertilizers: urea, nitrogen phosphorus (NP), diammonium phosphate (DAP), and calcium ammonium nitrate (CAN). Our results showed that if all the nutrients are balanced, a moderate dose and timely application of fertilizers can increase plant growth and improve crop yield.

INTRODUCTION

Cotton is the second most important crop grown in Pakistan after wheat, and it occupies the largest agricultural area in Pakistan in comparison to other crops. Cotton generates the country's largest export revenues; moreover, the seed of cotton used for oil and meal accounts for 80% of the national production of oilseed. Cotton and cotton-related products account for 10% percent of the country's gross domestic product (GDP) and 55% of its foreign exchange earnings. The number of acres used to cultivate cotton has increased significantly in the last 30 years; in 2015–2016, it consisted of around 7.86 million acres (Rehman *et al*. 2016). Globally, Pakistan is the fourth largest cotton producing country in the world, after China, India, and the United States (US). Fertilizers are the primary substance used to increase crop yield, and they can have an impact on pest populations by reducing a plant's resistance to insects. Increased application of synthetic fertilizers, especially nitrogen (N), would lead to a significant increase in the number of herbivorous pests. Hassan (1991) observed that the high cost of inputs, the scarcity of financial resources, the lack of access to markets, and untrained farmers contribute to a low yield per hectare, ultimately decreasing the benefits of their use to farmers. In many developing countries a variety of fertilizer management technologies are suitable for use in regional agricultural and socio-cultural structures, such as crop management knowledge models (Paustian and Theuvsen 2017), N fertilizer models (Yan *et al*. 2006), leaf color charts (LCC) (Zhu *et al.* 2007), and soil–plant analysis development (SPAD), but their adoption rates are very low. Greater synchronicity between crop demand and nutrient supply is necessary to improve nutrient-use efficiency, especially for N (Johnson *et al.* 1997).

Through its Better Cotton Initiative (BCI), the Centre for Agriculture and Biosciences International (CABI) conducted a study to observe the effects of different combinations and doses of fertilizers on cotton growth and crop yield. It was hoped that the results would be helpful for selecting a suitable combination and dose of fertilizers.

MATERIALS and METHOD

Experiment

Under the auspices of the BCI, CABI conducted a study in Mirpur Khas, Pakistan, in a field at a latitude of 25°31'30.36"N, a longitude of 69°0'57.24"E, and an altitude of 17m.a.s.l. Seeds of Bt-886 cotton were sown in April on ridges and furrows with a two-foot, row-to-row distance, an average temperature of 25±5°C and an average relative humidity (RH) of 70±10. The plant-to-plant distance was approximately 9 inches, and the crop was maintained after 25 days of germination. The fields were irrigated and weeded (using hand tools) on the basis of need. The field was divided into six areas, each treated with different combinations and doses of urea, nitrogen phosphorus (NP), diammonium phosphate (DAP), and calcium ammonium nitrate (CAN), as follows:

T1=urea-494.16, NP-247.08, DAP-123.54, and CAN-123.54
T2=urea-494.16, NP-247.08, and DAP-123.54
T3=urea-494.16 and NP-247.08
T4=urea-494.16, NP-247.08, DAP-123.54, and CAN-123.54
T5=urea-247.08, NP-123.54, DAP-123.54, and CAN-123.54
T6=urea-123.54, NP-123.54, DAP-123.54, and CAN-123.54

The fertilizers were applied at same time for all six treatment combinations. DAP was applied before sowing, and the other fertilizers were applied 25 days after germination.

Data Collection

Data was recorded from the first picking of cotton; there was a total of four pickings in the season. The first picking began 80 days after sowing when 50% of the bolls were opened. The other pickings were done at an interval of 15

days. Plant growth was recorded at the final picking.

Data Analysis

The mean number of treatments were compared and analyzed using Microsoft Office Excel 2010. All figures were prepared using Microsoft Office Excel 2010.

RESULTS

There were six treatment combinations, each with different fertilizer doses applied at different times. The T1 treatment included urea, NP, DAP, and CAN (494.16, 247.08, 123.54, and 123.54, respectively). It was found to give the highest crop yield of 2809.65±55.90 kg/acre (Figure 1). The second highest crop yield was observed for the T2 treatment, which contained urea, NP, and DAP (494.16, 247.08, and 123.54, respectively); the T2 crop yield was 2798.62±85.64 kg/acre (Figure 2). T3 included urea and NP (494.16 and 247.08, respectively); it resulted in a crop yield of 2500.15±26.46 kg/acre (Figure 3). All of the fertilizers in T4 (Urea-494.16, NP-247.08, DAP-123.54, and CAN-123.54) were the same as those used in T1, but the T4 fertilizer combination was applied frequently without any schedule. However, its crop yield was low 2287.65±61.09 kg/acre (Figure 4). T6 included urea (123.54), NP (123.54), DAP (123.54), and CAN (123.54), but its crop yield was only 2234.9±62.57 kg/acre (Figure 5). The lowest crop yield (2187.65±67.34) of all six treatment options was obtained from the T5 combination, which included all four fertilizers, urea (247.08), NP (123.54), DAP (123.54), and CAN (123.54), but its application was random (Figure 6).

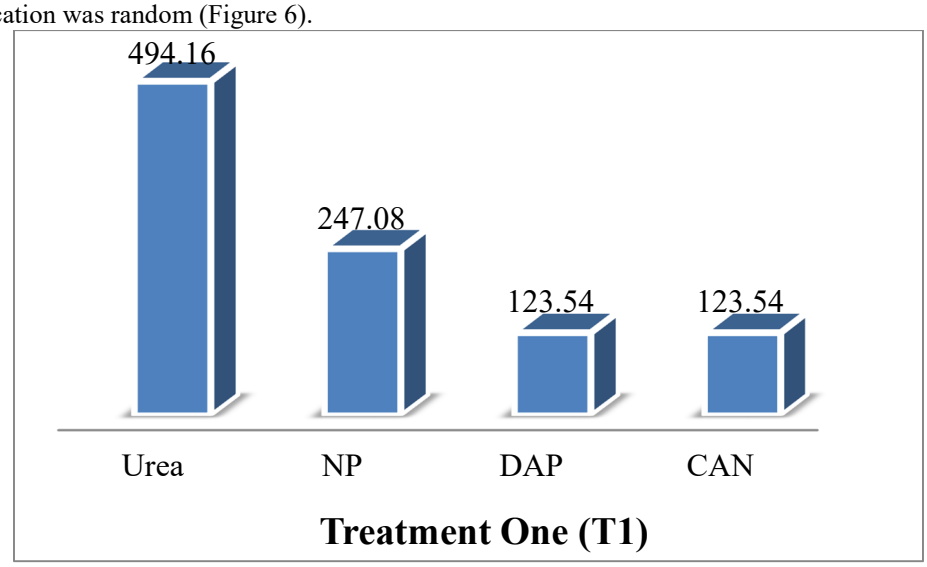

Figure 1. Applications of the T1 fertilizers. Data are the mean of four replications.

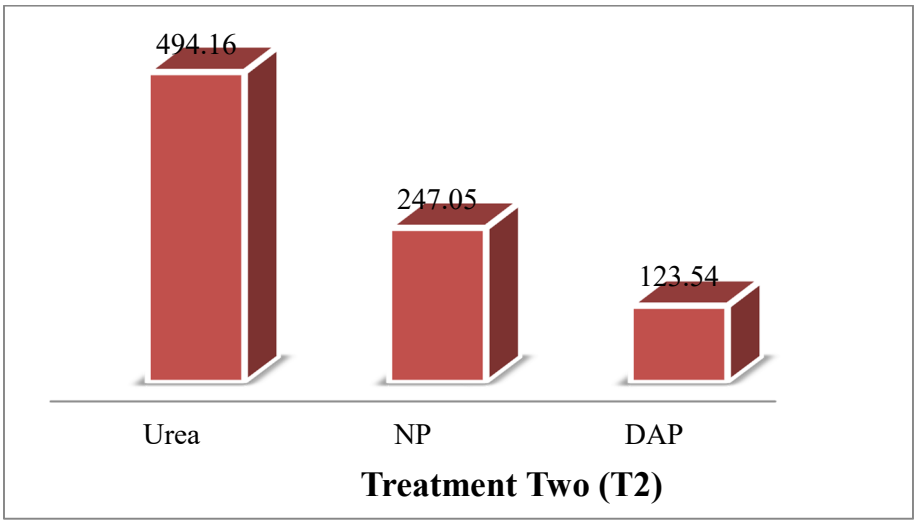

Figure 2. Applications of the T2 fertilizers. Data are the mean of four replications.

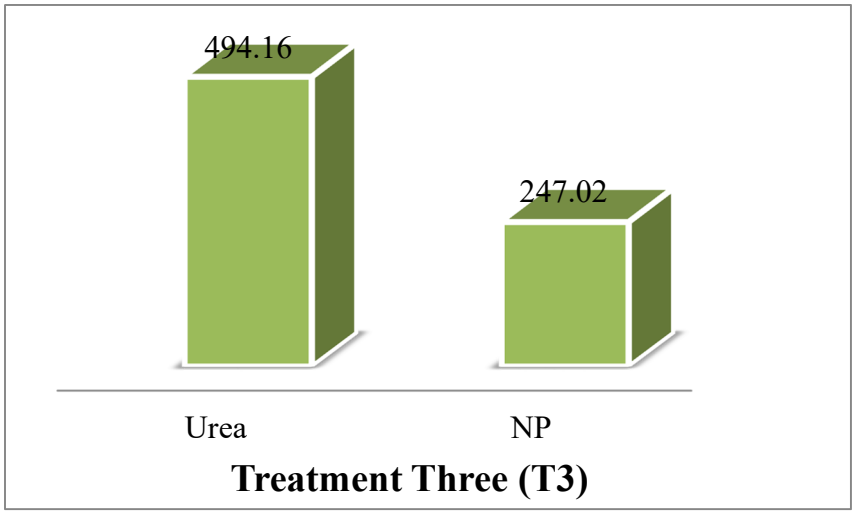

Figure 3. Applications of T3 fertilizers. Data are the mean of four replications.

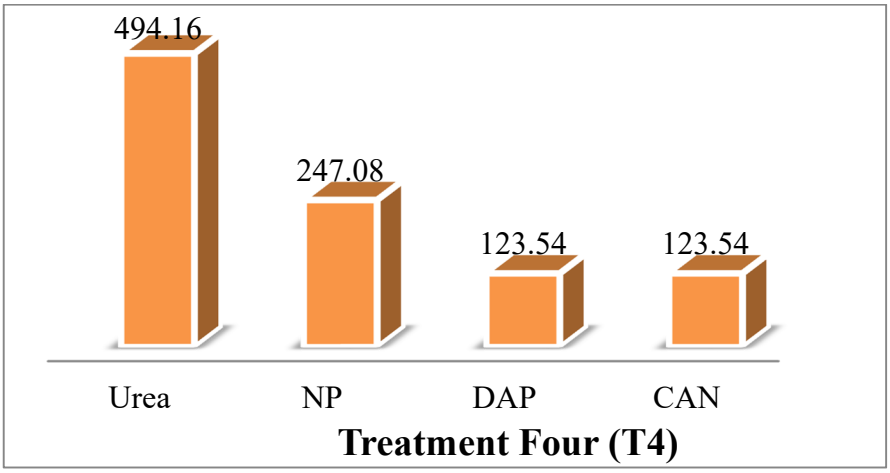

Figure 4. Applications of the T4 fertilizers. Data are the mean of four replications.

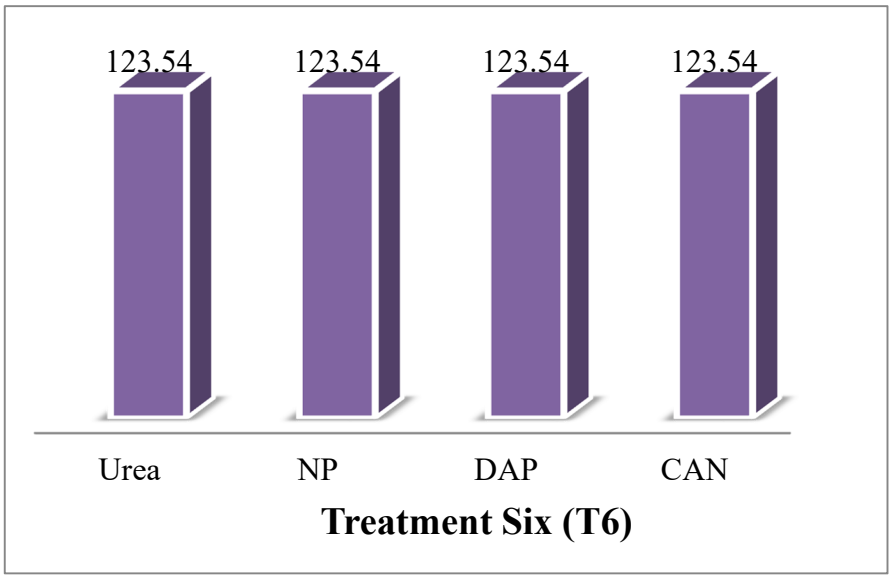

Figure 5. Applications of T6 fertilizers. Data are the mean of four replications.

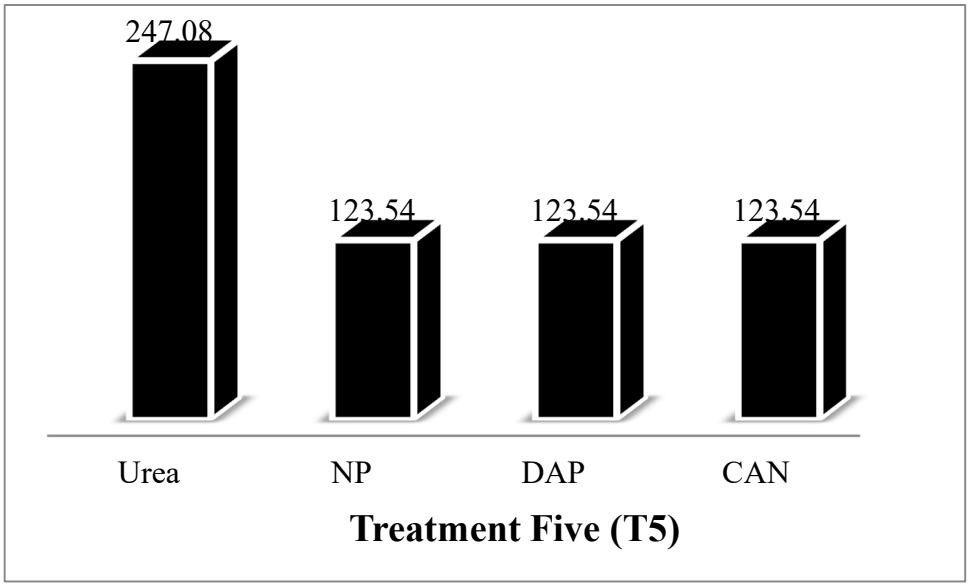

Figure 6. Applications of the T5 fertilizers. Data are the mean of four replications.

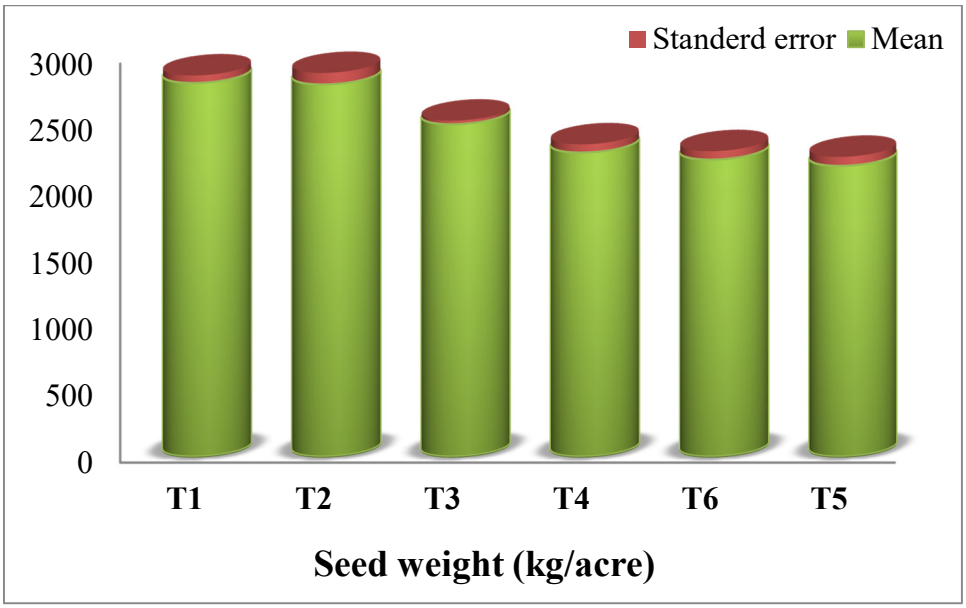

Figure 7. Seed weight of the cotton crop yield in kilograms per acre. Data are the mean of four replications.

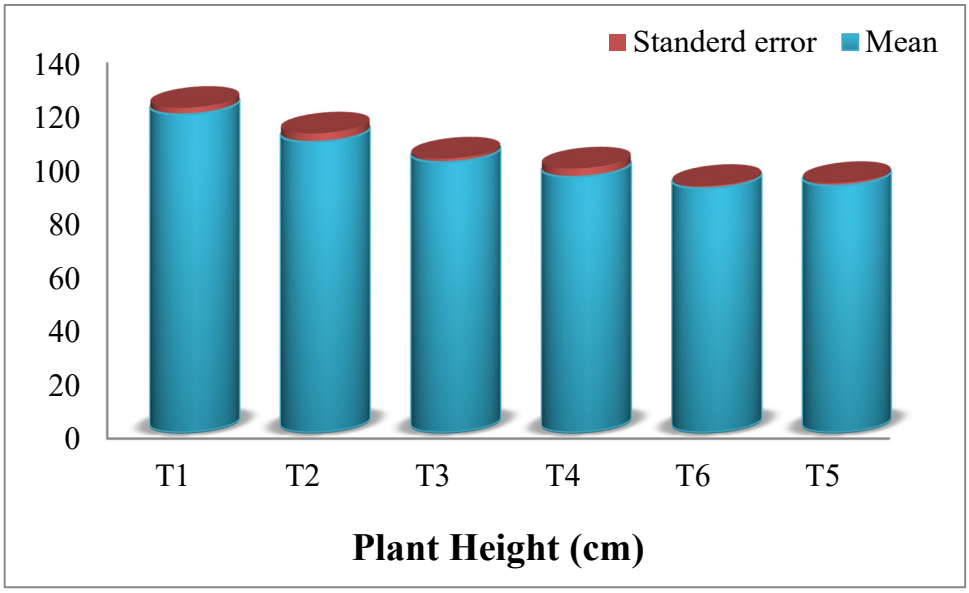

Figure 8. Plant height recorded with the six different fertilizer treatments. Data are the mean of four replications.

Our results showed that if all the nutrients are balanced, a moderate dose and timely application of fertilizers can improve crop yield. The highest doses of fertilizers were used in T4 and T1, followed by T5, T6, T2, and T3. However, maximum crop yield was obtained from T1 followed by T2, T3, T4, T6, and T5 (Figure 7). The plant growth results showed that a moderate and timely dose of fertilizer can give the maximum plant height. The maximum plant height was observed from the T1 treatment, followed by the T2, T3, T4, T6, and T5 treatments (118.75±2.39 cm, 108.5±3.12 cm, 101±1.29 cm, 95.5±3.1 cm, 91.25±0.85 cm, and 92.25±0.95 cm, respectively) (Figure 8).

DISCUSSION

We observed from our results that moderate dose of different fertilizers and their timely application can increase plant growth as well as crop yield. The same results of fertilizer efficiency was described by Sami and Yassin (2012) that grain yield can be increased significantly with increasing of fertilizer doses between 86 and 129 kg/ha, however application methods of fertilizers not effecting the yield. Our results showed that application of nitrogen fertilizer with other fertilizers can increase plant vegetative growth and yield. The use of Nitrogen fertilizer will be effective for plant growth and yield when it mixed with other fertilizer such as potassium. The high nitrogen content in the field will improve high uptake of nitrogen (Khalifa *et al.* 2012). The application of phosphorous with other fertilizers can increase the plant vegetative growth which can increase its straw (Rahman 1997). Nitrogen application can be effective if it is applied at the time then plant demand is high with divided of fertilizer applications (Setatou and Simonis 1995).

REFERENCES

1. Rahman A. and F. M.A. 1997. The effect of phosphorus and time of nitrogen application on growth and yield of wheat (*Triticum aestivum L.*). MSc. Thesis. U of K, Sudan.
2. Abdul Rehman A., Jingdong L., Chandio A.A, Hussain I, Wagan S.A. and Memon Q.A. 2016. Economic perspectives of cotton crop in Pakistan: A time series analysis (1970–2015) (*Part 1*). Journal of the Saudi Society of Agricultural Sciences, https://doi.org/10.1016/j.jssas.
3. Setatou H.B., and Simonis A.D. 1995. Effect of time and rate of nitrogen application on cotton. Fertilizer research, 43 (1-3): 49-53
4. Hassan I. 1991. Determination of factors inhibiting adoption of improved technology in cotton production. M.Sc. (Agric. Econ.) Thesis, University of Agriculture, Faisalabad.
5. Johnson J.W., Murrell T.S., Reetz H.F. 1997. Balanced fertility management: a key to nutrient use efficiency. Better Crops 81:3-5
6. Khalifa K., Al-Chammaa M. and Al-Ain F. 2012. Effect of Potassium Fertilizers on Cotton Yield and Nitrogen Uptake Efficiency in an Aridisol, Communications in Soil Science and Plant Analysis, 43(16): 2180-2189,
7. Paustian M. and Theuvsen L. 2017. Adoption of Precision Agriculture technologies by German crop Farmers. Precis. Agric., 18, 701.
8. Mahgoub S.A.G. and Ibrahim Y.M. 2012. Performance of wheat yield under different fertilizer types,

application and doses at Northern Sudan State. Agriculture and Biology Journal of North America, 3(3): 125-130.

9. Yan D., Zhu Y., Wang S. and Cao W.A. 2006. Quantitative knowledge-based model for designing suitable growth dynamics in rice. Plant Prod. Sci. 9: 93-105.
10. Zhu Y., Cao W., Dai T., Tian Y. and Yao X. 2007. A knowledge model system for wheat production management. Pedosphere, 17: 172-181.