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Assessment of Optimum Nitrogen Requirement and Economics of Cotton (*Gossypium hirsutum* L.) Crop for Seed Yield

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ABSTRACT

A field experiment was conducted at Adaptive Research Farm, Vehari for three consecutive years (2000 to 2002) to assess the optimum nitrogen requirement of cotton crop for maximum yield of seed cotton. Six nitrogen levels viz. 0, 80, 120, 140, 200 and 250 kg ha^{-1} were tested. The studies concluded that 200 kg N ha^{-1} is optimum nitrogen requirement of cotton variety FH–901. Moreover, the cotton crop did not response to higher dose of N fertilizer. On the average of three years, 200 kg N ha^{-1} gave 74.97% net income increase over zero N. Marginal analysis revealed that 80 kg N ha^{-1} was the most economical treatment with maximum MRR (844.94%) followed by 140 kg N ha^{-1} with MRR (562.76%).

Key Words: *Gossipium hirsutum* L.; Nitrogen; Fertilizer; Yield; Economics; Pakistan

INTRODUCTION

Cotton is the most important cash crop of Pakistan. Unfortunately its per hectare yield is very low as compared to other cotton growing countries of the world. Efforts to increase the yield of seed cotton are continuing through adopting improved agronomic practices. Nitrogen is utilized by cotton plant in greater quantities and generally considered the most important element for increasing yield. A suitable supply of nitrogen ensures a fine green colour in the foliage, a rapid and vigorous plant growth, a greater development of fruiting branches, a large number of flowers and sound bolls and consequently high yields (Awan, 1988). Soil tests carried out in Pakistan indicated a general deficiency of nitrogen and the nitrogen response to different crops is overwhelming in all types of soils (Wahab, 1985).

Several workers (Bhatti & Khan, 1973; Hayat *et al.*, 1979; Singh, 1979; Khan & Gurmani, 1988) have obtained significant increase in seed cotton yield due to nitrogen application. Abdullah (1973) stated that the response due to fertilizer would depend on soil fertility and previous crop. Hashmi *et al.* (1975) observed that 100 lbs N $acre^{-1}$ gave maximum yield of seed cotton. Whereas, Varshney (1979) has reported that increased nitrogen application increased the seed cotton yield and recommended optimum N dose as 131 kg ha^{-1}, while Suhag *et al.* (1981) working on fertilizer requirements of cotton under Sindh conditions on two soil series found that the application of 112 lbs N + 50 lbs P_2O_5 per acre proved superior and seems attractive in return.

On the basis of three years average data, Tariq and Ahmad (1985) concluded that 112 kg nitrogen in combinations with 56 kg of phosphorus per hectare is the most appropriate dose for getting the highest yield of seed cotton and net cash return. Khan *et al.* (1993) on the basis of three years experiments concluded that 224 kg N ha^{-1} gave 106.8% increase in seed cotton yield over control. Khan *et al.* (1994) and Latif *et al.* (1994) were of the view that 100 kg N ha^{-1} was the optimum N requirement for cotton under Faisalabad and Sakrand conditions, respectively.

Keeping in view the importance of nitrogen in increasing the cotton production, the present study was carried out to evaluate the optimum nitrogen requirement for cotton cultivar FH–901 during the years Kharif 2000 to 2002 at Adaptive Research Farm, Vehari.

MATERIALS AND METHODS

The experiments were laid out on FH–901 for three consecutive years 2000 to 2002 at Adaptive Research Farm, Vehari. The physical and chemical analysis of the experimental area (Table I) was determined in the year 2000. Studies were carried out on the same locality during subsequent years.

Table I. Physical and chemical analysis of the experimental area during the year 2000

Soil characteristics	Value
pH	8.2
Organic matter (%)	0.31
Available P (ppm) Olsen Method	4.50
Available K (ppm)	225
EC (dS m^{-1})	0.23
Texture	Loam

The experiment was conducted in randomized complete block design having three replications and a plot size of 10.5 m x 15 m. The crop was sown on 21.05.2000, 17.05.2001 and 10.05.2002 on a well prepared seed bed in 75 cm apart rows with a single row cotton hand drill.

P_2O_5 and K_2O @ 57, 62 kg ha^{-1} as single superphosphate and sulphate of potash, respectively, were applied as a basal dose in all the treatments except T_1 and T_2 whereas six levels of N viz. 0, 80, 120, 140, 200 and 250 kg ha^{-1} were applied in two equal splits, at first irrigation and

3rd irrigation as urea. The irrigations were applied according to the requirement of the crop. Moreover, the proper plant protection measures were adopted keeping in view the pest situation in cotton crop with standard cultural practices to raise the crop. The seed cotton was hand picked and weighed for plot yields and then calculated in kg ha^{-1}. The data were analyzed by using Duncan's Multiple Range Test (Duncan, 1970) to compare the treatment means.

RESULTS AND DISCUSSION

The yield data (Table II) revealed a positive response to increased doses of N from 0–250 kg N ha^{-1}. The highest yield of seed cotton on the basis of three years combined average was 2029.32 kg ha^{-1} from the crop receiving highest dose of 250 kg N ha^{-1} and was statistically similar to 200 kg N ha^{-1} (2013.37 kg ha^{-1}). Crop growth without N fertilization gave lowest yields during all the years under study.

Highly significant differences in yield performance were manifested from year to year but the trends remained almost the same. It signifies that cotton variety FH–901 is adequately stable concerning its genetic potential for yield of cotton. The results are in good agreement with the findings of Khan *et al.* (1993) who concluded that 224 kg N ha^{-1} is the optimum N requirement for cotton variety S–12 under Multan conditions.

Economic analysis (Table III) indicated that all the levels of nitrogen fertilizer gave substantial higher income per hectare over control. There was progressive increase in net income per hectare with each successive dose of nitrogen fertilizer. The highest net income of Rs. 41222.06 per hectare was recorded for 200 kg N ha^{-1} as against Rs. 40604.86, 39379.34, 37128.3, 37077.68 and 23558.64 ha^{-1} for 250, 140, 120, 80 and 0 N ha^{-1}, respectively. While

Table II. Evaluation of different levels of nitrogen fertilizer on cotton

Nutrient doses N - P_2O_5-K_2O (kg ha^{-1})	Yield of seed cotton (kg ha^{-1}) 2000	2001	2002	Average
00-00-00	798.49 d	1123.92 e	1022.43 d	981.61 e
80-00-00	1326.51 c	1829.08 d	1679.10 c	1611.57 d
120-57-62	1502.85 bc	2032.32 c	1793.22 bc	1776.13 c
140-57-62	1585.33 ab	2199.68 b	1874.75 ab	1886.59 b
200-57-62	1686.61 a	2367.05 a	1986.45 a	2013.37 a
250-57-62	1701.57 a	2383.43 a	2002.96 a	2029.32 a

Means followed by similar letter (s) are not significantly different from each other according to DMR Test; Cd_1 = LSD values were 118.51, 111.11 and 100.08 in years 2000, 2001 and 2002, respectively; Cd_2 = LSD values were 179.53, 119.04 and 151.58 in years 2000, 2001 and 2002, respectively

Table III. Economic analysis on the basis of three years average data

Nutrient doses N - P_2O_5-K_2O (kg ha^{-1})	Yield (kg ha^{-1})	Gross income (rupees)	Cost of fertilizer (rupees)	Net income (rupees)	Net income increase over check (%)
00-00-00	981.61	23558.64	--	23558.64	--
80-00-00	1611.57	38677.68	1600.00	37077.68	57.38
120-57-62	1776.13	42627.12	5498.82	37128.30	57.59
140-57-62	1886.59	45278.16	5898.82	39379.34	67.15
200-57-62	2013.37	48320.88	7098.82	41222.06	74.97
250-57-62	2029.32	48703.68	8098.82	40604.86	72.35

Cost of commodities, i) Seed cotton yield = Rs.24.00 per kg, ii) Nitrogen from urea = Rs.20.00 per kg, iii) Phosphorus from SSP = Rs.28.26 per kg, iv) Potash from SOP = Rs.24.00 per kg (including cost of variable factors)

Table IV. Marginal analysis on the basis of three years average data

Nutrient doses N - P_2O_5-K_2O (kg ha^{-1})	Costs that vary (rupees)	Marginal cost (rupees)	Net benefit (rupees)	Marginal net benefit (rupees)	Marginal rate of return (MRR) %
00-00-00	0	0	23558.64	0-	0
80-00-00	1600	1600	37077.68	13519.04	844.94
120-57-62	5498.82	3898.82	37128.30	50.62	1.298
140-57-62	5898.82	400	39379.34	2251.04	562.76
200-57-62	7098.82	1200	41222.06	1842.72	153.56
250-57-62	8098.82	1000	40604.86	-617.2	D

D = dominated due to less net benefits than the preceding treatments; MRR = MRR was calculated by dividing the marginal net benefit by the marginal cost and expressed as percentage

marginal analysis (Table IV) depicted that 80 kg N ha^{-1} was the most economical treatment with maximum MRR (844.94%) followed by 140 kg N ha^{-1} with MRR (562.76%) and 250 kg N ha^{-1} was uneconomical due to higher cost. This clearly indicates that nitrogen application improved the profitability.

CONCLUSION

The results of this study indicate that 80 kg N ha^{-1} could be a useful practice with relatively less cost but at existing prices application of 200 kg N ha^{-1} gave the maximum net benefits (Rs. 41222.06) for progressive growers.

REFERENCES

Abdullah, M., 1973. *Cotton Hand Book of Pakistan*, p. 16

Anonymous, 1994. *F.A.O. Production Year Book*, 48: 116–7

Awan, M.N., 1988. *Cotton Soils and Fertilizers.* Pakistan Main Kipas. P.C.C.C. Karachi

Bhatti, M.S. and M.A. Khan, 1973. Extensive fertilizer trials on cotton in the central region of West Pakistan. *The Pakistan Cottons,* 17: 31–3

Duncan, D.B., 1970. Multiple Range and Multiple F. Test. *Biometrics*, 11: 1–42

Hashim, M., M. Razzak and M.T. Chaudhry, 1975. Effect of time of application of moderate and high doses of nitrogen on yield of seed cotton in Sindh. *The Pakistan Cottons,* 19: 114–22

Hayat, M., M. Bhatti and M. Rashid, 1979. Use of fertilizer for higher production of cotton in Punjab. *The Pakistan Cottons,* 23: 219–27

Khan, M.D., M. Hassan, M.A. Khan and M. Ibrahim, 1993. Optimum dose and time of application of N on cotton variety S–12, yield and yield components. *The Pakistan Cottons,* 37: 91–6

Khan, R., A.W. Soomro and A.S. Arain, 1994. Evaluation of different sources and rate of nitrogenous fertilizers on cotton yield and its components. *The Pakistan Cottons,* 38: 81–92

Khan, S.U. and A.H. Gurmani, 1988. Studies on the relative effects of fertilizer, plant density and plant protection measures on seed cotton yield. *The Pakistan Cottons,* 32: 94–100

Latif, A., S.M. Alam, A. Hamid and Z. Iqbal, 1994. Effect of rate and time of N application along with P on yield and quality of cotton NIAB–78 and NIAB–86. *The Pakistan Cottons,* 38: 99–105

Singh, K., 1979. Effect of NPK on seed cotton yield and other characters of Desi cotton. *Soils and Fert.*, 42: 273

Suhag, S.M., A.B. Memon and N.A. Jhatyal, 1981. Fertilizer requirements of cotton for two soil series in Sindh. *The Pakistan Cottons,* 25: 161–68

Tariq, A., R.M. Ahmad, 1985. Economics of nitrogen and phosphorus application on upland cotton in Haroonabad. *The Pakistan Cottons,* 29: 210–16

Varshney, O.P., 1979. Effect of N, P and K alone and in various combinations on the development, yield of cotton (*Gossypium hirsutum* L.). *Soils and Fert.*, 42: 273

Wahab, A., 1985. Crop response to fertilizer and soil data interpretation. F.A.O. Project. UEDC/069/Pak

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