http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 4 (3): 371-373, 2001

Evaluation of Timings of Nitrogen Fertilizer Application for Cotton Production

Abdul Wahid Soomro, Abdul Razaque Soomro, Rashiduddin Khan,
Abdul Sattar Arain, Mohammad Siddique Chang and Allah Bux Leghari
Central Cotton Research Institute, Sakrand, Sindh, Pakistan

Abstract: Cotton is an economically important crop and experiments to determine its response to application of nitrogen fertilizer at proper time is of prime importance in research. Thus a field trial was conducted to evaluate the impact of nitrogen fertilizer application at various timings on seedcotton yield at CCRI, Sakrand. The treatments consisted of four timings of nitrogen application (planting, squaring, flowering and peak flowering). Cotton cultivar CIM-443 was planted during second week of May and 100-kilogram nitrogen fertilizer per hectare as urea was applied at various timings during the season. The results revealed that there is a significant impact of multiple split application of nitrogen fertilizer. Crop receiving 4-equal splits of nitrogen application at various growing stages of cotton crop proved better and gave better yields than the rest.

Key words: cotton, nitrogen, timely application, yield components, soil fertility

Introduction

For a healthy growth and better yield cotton crop needs continuous supply of essential nutrient elements. Deficiency or toxicity of any one nutrient results in reduction of plant growth and ultimately yield. It is established fact that optimum nutritional requirement of cotton is of primary importance to boost up its production. Experiments to determine the response of cotton to various rates and fertilizers have always been an important part of research in Pakistan and a balanced supply of nutrients at proper time is essential to rise per hectare yields. Among fertilizers, nitrogen application plays an important role in raising cotton production. Nitrogen is utilized in cotton plant to a greater extent and is generally considered the most important nutrient for maximizing the cotton yield (Singh, 1979; Hayat *et al*., 1979; Breitenbeck and Boquet, 1993). An adequate supply of nitrogen is essential for well-developed growth, fruiting and yield of cotton crop (Boquet *et al*., 1994; Chaudhry and Sarwar, 1999). It is widely recognized that nitrogen supply exerts a marked influence on vegetative and reproductive growth. In recent years there has been tendency among some cotton growers to increase maximum yield potentials by applying higher amount than that recommended nitrogen rates. Boquet *et al*. (1994) and Soomro *et al*. (1997) have found that increasing rates of nitrogen increased plant height and the number of flowers and bolls, but do not increase seedcotton yields because of increased shedding of lower bolls. Moreover, they added that excessive nitrogen fertilization does not improve the yield potential or profitability of cotton production. Cotton requires large amounts of N, particularly under irrigated cropping system.

The amounts of fertilizer N applied to cotton should be sufficient to achieve maximum returns from the crop and to avoid excessive vegetative growth, greater incidence of disease and greater attractiveness to insect pests (Hearn, 1975; Constable and Hearn, 1981; Boquet *et al*., 1994). It is also important to minimize the potential contamination of groundwater with nitrate from excessive use of fertilizer on light textured soils. The maturity of the cotton crop, as evidenced by first and second picking was found to be dependent on the N rate (Mascsagni *et al*., 1993). Fertilization is now a system problem and research has to quantify the relationships between all the factors of the fertilization and create models in order to help farmers to manage their crop (Bisson *et al*., 1994).

It has been advocated that recovery of applied nitrogen is very low when the crop is grown under irrigation (Soomro and Waring, 1987; Tahir and Salim, 1992; Soomro *et al*., 1999). The applied nitrogen may be lost from the soil plant system through leaching and denitrification resulting in yield reductions (Wayne, 1986). Thus application of nitrogen at proper time and proper doze is an important tool to increase per hectare yield of seedcotton. Keeping this fact in view, the present study was undertaken to determine the effect of split application of nitrogen on seedcotton yield and its components.

Materials and Methods

Field experiment was conducted at Central Cotton Research Institute, Sakrand during 1999 cotton season. Soil samples (0-20 cm) were collected at the time of sowing to study the nutrient status of soil. The values of physical and chemical characteristics for the experimental site are presented in Table 1, which demonstrates that the soil was calcareous in nature, alkaline in reaction and free of excessive salts. It was rich in potash, low in organic matter, total nitrogen and available phosphorus.

Cotton cultivar CIM-443 was planted during the second week of May at a plant configuration 75 × 20 cm, layout of the experiment was randomized complete block design with tow

Table 1: Physical and chemical characteristics of the experimental site at pre-plant stage (0-20 cm depth)

Soil Characteristics	Value
pH	8.5
Ec (1:1)	1.15
Organic Matter (%)	0.62
Total Nitrogen (%)	0.02
Available Nitrate, Nitrogen (ppm)	2.5
$NaHCO_3$ extracted P (ppm)	5.0
NH_4OAc extracted K (ppm)	278
Texture class	Clay loam

replications. Urea, single super phosphate and sulphate of potash were used as source of nitrogen, phosphorus and potassium respectively. P and K at the rate of 50 kg ha^{-1} and 40 kg ha^{-1} were applied at the time of sowing. Standard agronomic practices and plant protection measures were uniform and normal for all the treatments. The data were analyzed and Duncan Multiple Range Test (Duncan, 1955) was used to compare the treatment means.

The nitrogen application treatments were

		Time of application		
Treatments	Pre-plant	1st square	Flower initiation	peak flowering
T_1	100kg N ha^{-1}	-	-	-
T_2	-	100kg N ha^{-1}	-	-
T_3	-	-	100kg N ha^{-1}	-
T_4	-	-	-	100kg N ha^{-1}
T_5	50kg N ha^{-1}	50kg N ha^{-1}	-	-
T_6	-	-	50kg N ha^{-1}	50kg N ha^{-1}
T_7	-	33kg N ha^{-1}	33kg N ha^{-1}	33kg N ha^{-1}
T_8	25kg N ha^{-1}	25kg N ha^{-1}	25kg N ha^{-1}	25kg N ha^{-1}

Table 2: Yield components as affected by application of nitrogen fertilizer at various timings

Treatments	plant height (cm)	Bolls picked/ plant	Boll weight (g)	Seed index (g)	Lint index (g)
T_1	91.2a	26.8ab	2.5a	7.0a	4.1a
T_2	94.4a	25.5b	2.4a	7.8a	4.3a
T_3	92.8a	27.2ab	2.3a	7.8a	4.2a
T_4	97.8a	26.4ab	2.3a	7.1a	4.0a
T_5	94.0a	27.7ab	2.3a	7.2a	3.9a
T_6	90.2a	28.5ab	2.5a	7.7a	4.3a
T_7	97.1a	29.2ab	2.4a	7.5a	4.0a
T_8	98.0a	29.9a	2.5a	7.6a	4.3a

Means followed by similar letter do not differ significantly from each other according to the DMR test

Table 3: Biological yield as affected by application of nitrogen fertilizer at various timings

	Biological yield (g/m^2)			
Treatments	Leave	Stalks	Fruit	Total
T_1	106ab	113bc	142d	351 d
T_2	119ab	103bc	159cd	381 cd
T_3	142a	99c	201bc	442 b
T_4	93b	104bc	166cd	363 d
T_5	120ab	105bc	193bc	418bc
T_6	110ab	108bc	163cd	381cd
T_7	115ab	124ab	227ab	466ab
T_8	112ab	138a	247a	497 a

Means followed by similar letter do not differ significantly from each other according to the DMR test

Results and Discussion

Yield of seedcotton and its components: The results presented in Fig. 1 revealed that the yield of seedcotton was significantly affected by nitrogen fertilizer application at various timings and splits. Lowest yield was obtained when the nitrogen was applied at peak flowering in full doze.

Table 4: Nitrogen uptake as affected by application of nitrogen fertilizer at various timings

Treatments	Nitrogen uptake (kg ha^{-1})			
	Leave	Stalks	Fruit	Total
T_1	22.9 a	22.0 b	20.5 c	65.4a
T_2	22.4 a	19.4 b	21.7 c	63.5a
T_3	20.5 a	19.4 b	27.3 ab	67.2ab
T_4	18.8 a	21.3 b	23.4 bc	63.5a
T_5	18.0 a	23.1 b	27.8 ab	68.9ab
T_6	24.0 a	19.8 b	22.5 c	66.3a
T_7	21.5 a	22.4 b	28.3 a	72.2b
T_8	20.5 a	28.2 a	30.2 a	78.9c

Means followed by similar letter do not differ significantly from each other according to DMR test

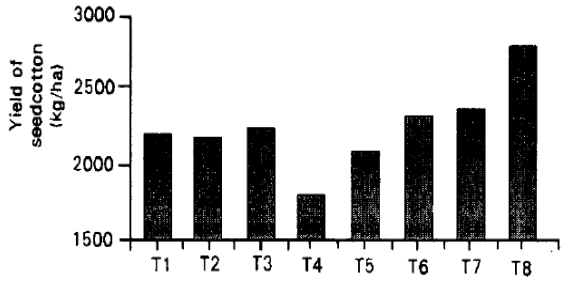

Fig. 1: Yield of seed cotton as affected by nitrogen fertilizer application at various tinings

Highest return was achieved from T_8 when the nitrogen was applied in four equal splits. This explains that application of nitrogen as a single doze is totally waste of money, because all nitrogen is wasted by soil and is not available to the plant when the nutrient is direly required by cotton at bloom. Thus, fertilizer applied at peak flowering showed drastic impact on seedcotton yield. On the other hand, when the nitrogen application was divided into four equal splits and applied at various growing stages of the cotton crop, proved best and highest yield was obtained as compared with the other treatments where the nitrogen was applied as a single doze or in two or three splits. Number of bolls picked per plant (Table 2) due to treatments was also significantly increased in treatment where nitrogen was applied in four equal splits. It is therefore suggested that for getting maximum yield, nitrogen fertilizer should be applied at proper time and in splits. The results are in agreement with the findings of Knowles *et al*. (1993) and Soomro *et al*. (1999) who have found that split application of nitrogen fertilizer have the potential to provide an adequate supply of nitrogen throughout the growing season without risking large nitrogen fertilizer losses via leaching or denitrification. Soomro and Waring (1987) have also reported similar findings.

Biomass production: The data revealed that highest dry matter was produced with the application of four splits; on the other hand lowest dry matter was produced when nitrogen was applied in single doze at sowing (Table 3). The above findings are in agreement with Knowles *et al*. (1993) who have concluded that cotton plants take up a majority of their nitrogen prior to appearance of the first open boll. An adequate nitrogen supply during this vegetative period is essential for attaining optimum plant biomass accumulation

and lint yield. Breitenbeck and Boquet (1993) observed that cotton receiving no nitrogen was stunted and produced very low biomass. Soomro *et al*. (1999) have reported same trend in biomass production with the treatment receiving no nitrogen and treatments where nitrogen was applied in splits to the cotton plant.

Nitrogen uptake: Maximum nitrogen uptake and transfer of photosynthates to fruit was observed when nitrogen was divided into four equal splits and applied at various growing stages of the cotton crop (Table 4). This shows that nitrogen recovery is closely associated with the application of nitrogen fertilizer at proper time and doze. The findings are in agreement with the results reported by Soomro *et al*. (1999).

References

Bisson, P., M. Cretenet and E. Jallas, 1994. Nitrogen, phosphorus and potassium availability in the soil-physiology of the assimilation and use of these nutrients by the plant, challenging the future. Proceedings of the 1st World Cotton Research Conference, February 14-17, 1994, Brisbane Australia, CSIRO, Melbourne, pp: 115-124.

Boquet, D.J., E.B. Moser and G.A. Breitenbeck, 1994. Boll weight and within-plant yield distribution in field-grown cotton given different levels of nitrogen. Agron. J., 86: 20-26.

Breitenbeck, G.A. and D.J. Boquet, 1993. Effects of N-fertilization on nutrient uptake by cotton. Proceedings of Beltwide Cotton Conference, January 10-14, 1993, New Orleans, Louisiana, USA., pp: 1298-1300.

Chaudhry, A.U. and M. Sarwar, 1999. Optimization of nitrogen fertilization in cotton (*Gossypium hirsutum* L.). Pak. J. Biol. Sci., 2: 242-243.

Constable, G.A. and A.B. Hearn, 1981. Irrigation for crops in a sub-humid environment. VI. Effect of irrigation and nitrogen fertilizer on growth, yield and quality of cotton. Irrigat. Sci., 3: 17-28.

Duncan, D.B., 1955. Multiple range and multiple F tests. Biometrics, 11: 1-42.

Hayat, M., M. Bhatti and M. Rashid, 1979. Use of fertilizer for higher production of cotton in Punjab. Pak. Cottons, 23: 217-227.

Hearn, A.B., 1975. An economic assessment of the response of cotton to nitrogen and water in the Ord Valley, NW Australia. Cotton Grow. Rev., 52: 165-188.

Knowles, T.C., B.W. Hipp and W.C. Langston, 1993. Cotton responses to fertilizer and drip irrigation in the Texas Blackland. Proceedings of Beltwide Cotton Conference, January 10-14, 1993, New Orleans, Louisiana, USA., pp: 1360-1363.

Mascsagni, H.J.Jr., T.C. Keisling and R.L. Maples, 1993. Response of fast fruiting cotton cultivars to nitrogen on a clayey soil. J. Prod. Agric., 6: 27-29.

Singh, K., 1979. Effect of N, P and K on seedcotton yield and other characters of Desi cotton. Soil Fert., 42: 273-279.

Soomro, A.R., A.W. Soomro, W.A. Siddiqui, R.U. Khan and A.S. Arain, 1997. Nitrogen requirement of cotton in Sindh. Pak. Cotton, 41: 6-10.

Soomro, A.W. and S.A. Waring, 1987. Effect of temporary flooding on cotton growth and nitrogen nutrition in soils with different organic matter levels. Aust. J. Agric. Res., 38: 91-99.

Soomro, A.W., A.R. Soomro and G.H. Mallah, 1999. Recovery of nitrogen fertilizer and growth of cotton as affected by various levels of flooding. Pak. J. Biol. Sci., 2: 1507-1509.

Tahir, M. and M. Salim, 1992. Relative efficacy of different nitrogen sources and levels for wheat crop under rain fed conditions. Pak. J. Agric. Res., 13: 227-231.

Wayne, E.M., 1986. Evaluation of nitrogen sources and timing of application for cotton production. Proceedings of the Beltwide Cotton Production and Research Conference, (BCPRC'86), National Cotton Council of America, Memphis, TN., pp: 394-396.