

RESPONSE OF SEED COTTON YIELD TO VARIOUS PLANT POPULATIONS AND PLANTING METHODS

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ABSTRACT

Response of seed cotton yield to various plant populations and planting methods was studied at Adaptive Research Farm, Vehari, Pakistan during 2007 and 2008. Cotton variety CIM-496 was planted under three populations (88888, 59260 and 44444 plants/ha) maintained with plant spacings of 15, 22.5 and 30 cm, respectively and three planting methods viz. flat planting, ridge planting and bed planting in 75 cm apart rows. Average of two years data indicated that seed cotton yield was significantly higher in 59260 plants per hectare (2474 kg/ha) followed by 44444 (2324 kg/ha) and 88888 plants (2238 kg/ha). Among planting methods, bed planting gave significantly higher seed cotton yield (2290 kg/ha) than others.

KEYWORDS: *Gossypium hirsutum*, plant population, spacing; yield; Pakistan.

INTRODUCTION

Establishment of an acceptable population of cotton seedlings is important to obtain high yields (11). Its contribution ranged from 22.0 to 32.7 percent towards cotton yield (21) while planting method of different crops helps a lot for obtaining required plant population. Some researchers have observed reduced yields with extremely high or low plant populations (6,26) whereas several researchers have, however, concluded that plant population and seed cotton yield are unrelated (5,13,14,19,25,27). Soomro *et al.* (29) found that 23 and 30 cm plant spacings gave higher seed cotton yield than 15 and 38 cm and advised the growers to make thinning of cotton crop leaving 23-30 cm distance between plants. Plant population of 100,000 per hectare was optimum for cotton grown in 0.76 meter rows (31) while seed cotton yield decreased with increase in plant spacing (18). Khan *et al.* (20) concluded that

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plant spacing of 23 cm gave better yield than 30 and 38 cm spacing in cotton. Many scientists recommended 30 cm plant spacing for cotton crop (1,9,17,24,28) to obtain plant population of 44444 plants per hectare for maximum seed cotton yield. Ali *et al.* (3) suggested that cotton variety CIM-497 should be planted with 50000 plants per acre.

In Pakistan, flat planting of cotton is practiced in most of the cotton growing areas which may result in poor seed germination and patchy plant population. Some times after planting and before emergence of cotton seedlings, a light shower of rain results in crust formation which restricts the emergence of seedlings and causes poor plant population. Uniform plant population is the most important factor to harvest more profitable yield of all crops. Sowing of cotton on raised beds or ridges ensures adequate plant population due to better seed germination and emergence of seedlings even during unusual rains. Khan and Ullah (22) after studying various planting methods of cotton concluded that ridge sowing outyielded by producing 2582 kg per hectare seed cotton whereas Bridge *et al.* (8) observed no significant influence of planting methods on seed cotton yield. Planting on bed and furrow is the most appropriate and efficient method to fetch good seed germination and emergence of seedlings (15). Anwar *et al.* (4) reported that 33 percent higher seed cotton yield was obtained from bed-furrow planting as compared with flat planting. Similarly, Hussain *et al.* (16) concluded that ridge sowing produced significantly higher seed cotton yield (1729 kg/ha) than flat sowing (1683 kg/ha). Flat planted cotton was lower yielding than cotton planted on raised beds (7). Ali and Ehsanullah (2) concluded that flat planting with each row earthing up gave higher seed cotton yield than bed and ridge plantings. Bed sowing method was significantly superior to flat sowing method with 35 percent higher seed cotton yield in cotton-wheat rotation (10). Similarly furrow-bed seeded cotton increased lint yield by 25 percent compared with flat seeded cotton (12).

No systematic work has been done in the past in Pakistan to evaluate the response of seed cotton yield to various plant populations and planting methods. The present study was undertaken to find out optimum population of cotton seedlings at the most suitable planting method for improving seed cotton yield per unit area.

MATERIALS AND METHODS

This study was conducted at Adaptive Research Farm, Vehari, Pakistan during 2007 and 2008 on clay loam soil. Cotton variety CIM-496 was planted on May 11, 2007 and May 04, 2008 under three plant populations (88888,

59260 and 44444 plants/ ha) and three planting methods viz. flat planting, ridge planting and bed planting in 75 cm apart rows. The trial was laid out in split plot arrangement having plot size of 6 x 15 m². In plots allocated for flat planting, sowing was done on well prepared seed bed with single row cotton hand drill at “wattar” condition and at the same time ridges and beds were made with tractor mounted ridger and bed-furrow shaper in dry soil in ridge and bed planting treatments, respectively. Seeding was done manually with delinted cotton seed with 5-6 seeds per hill at 15, 22.5 and 30 cm plant spacings to achieve required plant populations according to the treatments and followed by irrigation. Pendimethalin 330E was applied (2.5 l/ha) at the time of seed bed preparation and then incorporated before drilling in flat planting treatment. In ridge and bed planting treatments same pesticide was sprayed 24 hours after seeding for weed control. The ridge and bed planting treatments were irrigated after 72 hours of sowing to ensure germination of unsoaked seed during first irrigation followed by subsequent irrigation at fortnightly interval. Gaps were also filled where seeds could not germinate to ensure required plant population. Normal irrigations were applied according to need of crop in different planting methods. In flat planting treatment plots were hand thinned three weeks after emergence to their respective plant populations whereas, at same time in ridge and bed plantings thinning was done leaving one plant per hill. Earthing up was completed in all treatments during last interculturing. Phosphatic fertilizer @ 57 kg P₂O₅ per hectare as single super phosphate was applied at or before sowing and 170 kg N per hectare as urea was applied in three splits and last application was done by mid of August every year. Plant protection measures were adopted against sucking insects and bollworms after pest scouting. The seed cotton yield data were recorded from central four rows of eight-row plot. Weather data on temperature and rainfall were recorded during crop growth period (Fig.).

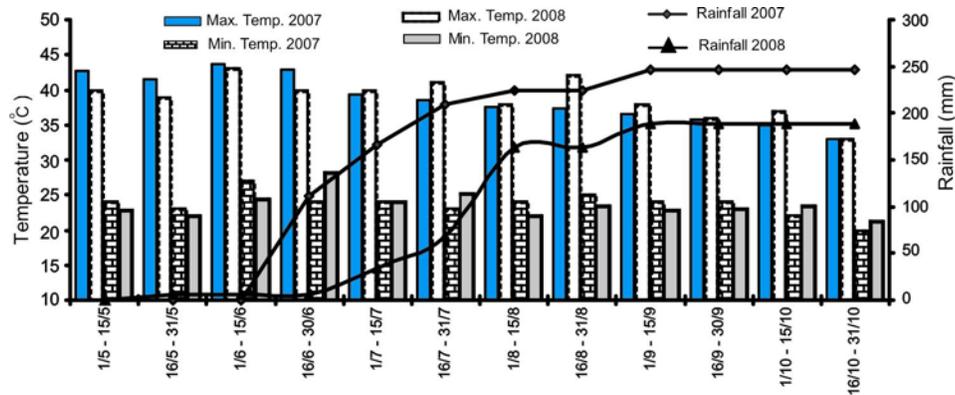


Fig. 1 Fortnightly maximum and minimum temperature (°C, bars) and total rainfall (mm, lines) for May to October, 2007 and 2008.

The data on seed cotton yield were calculated and analyzed statistically using Fisher's analysis of variance technique and significant differences among treatments means were tested using least significant difference (LSD) test at five percent probability (30).

RESULTS AND DISCUSSION

The data (Table) indicated that significantly higher seed cotton yield was obtained with plant population of 59260 plants per hectare followed by 44444 plants per hectare during both years. Among planting methods bed planting gave more seed cotton yield followed by ridge planting. On the basis of two years average also plant population of 59620 (2474 kg/ha) and bed planting (2462 kg/ha) excelled in seed cotton yield. Minimum seed cotton yield was produced by flat planting (2256 kg).

Table. Response of seed cotton yield to various plant populations and planting methods during 2007 and 2008.

Plant population/ha	Planting methods			Mean
	Flat planting	Ridge planting	Bed planting	
2007				
88888	2115	2137	2189	2147c
59260	2314	2336	2382	2344a
44444	2261	2245	2298	2268b
Mean	2230b	2239b	2290a	-
LSD>0.05:	Plant population=16.37, Planting method=49.73			
2008				
88888	2165f	2264e	2559c	2329c
59260	2428d	2626b	2757a	2604a
44444	2252e	2298e	2587bc	2379b
Mean	2281	2396b	2634a	-
LSD>0.05:	Plant population =18.93, Planting method =24.65 Plant population x Planting method=66.03			
Mean of two years				
88888	2140g	2200f	2374d	2238c
59260	2371d	2481b	2569a	2474a
44444	2256e	2272e	2443c	2324b
Mean	2256c	2318b	2462a	-
LSD>0.05:	Plant population=16.37, Planting method=49.73 Plant population x Planting method=32.79			

No significant effect of plant population x planting method interaction was found during 2007. However, significant differences were recorded during 2008 where maximum seed cotton yield was noted in 59260 plants per hectare with bed planting against minimum from 88888 plants with flat

planting. Two years average (Table) showed that plant population of 59260 remained at top with bed planting (2569 kg) and minimum from 88888 plants with flat plating (2140 kg). These results confirmed the earlier findings (20, 29) where better seed cotton yield was noted in 30 cm plant spacing. However, these results are in contrast to some other findings (1,9,17,24,28), where 30 cm plant spacing was recommended to obtain plant population of 44444 plants per hectare and maximum seed cotton yield. In some other earlier findings (4,7,10,12,15) it was concluded that bed sowing method was superior to flat sowing, while Hussain *et al.* (16) observed that ridge sowing produced significantly higher seed cotton yield than flat sowing. This is in contrast to the findings of Ali and Ehsanullah (2) who reported that flat planting gave higher seed cotton yield than bed planting and ridge planting.

CONCLUSION

The study concludes that maximum seed cotton yield can be obtained with plant population of 59260 plants per hectare. Moreover, bed planting method proved to be superior to ridge and flat plantings. Therefore, cotton growers are advised to adopt bed planting method with 22.5 cm plant spacing to maintain 59260 plants for maximum yield.

REFERENCES

1. Akhtar, M., M.S. Cheema, M. Jamil, M.R. Farooq and M. Aslam. 2002. Effect of plant density on four short statured cotton varieties. *Asian J. Pl. Sci.* 1:644-645.
2. Ali, L. and Ehsanullah. 2007. Water use efficiency of different planting methods in cotton (*Gossypium hirsutum* L.). *J. Agric. Res.* 45 (4):299-306.
3. Ali, M.A., M. Ali, K. Yar, M. Din and M. Yamin. 2007. Effect of nitrogen and plant population levels on seed cotton yield of newly introduced cotton variety CIM-497. *J. Agric. Res.* 45 (4):289-298.
4. Anwar, M.M., M.I. Gill and M.S. Zaki. 2003. Effect of bed-furrow planting on cotton crop. *The Pak. Cottons.* 47:41-46.
5. Bendnarz, C.W., D.C. Bridges and S.M. Brown. 2000. Analysis of cotton yield stability across population densities. *Agron. J.* 92:128-135.
6. Bendnarz, C.W., W.D. Shurley, W.S. Anthony and R.L. Nichols. 2005. Yield, quality and profitability of cotton produced at varying plant densities. *Agron. J.* 97:235-240.
7. Boquet, D.J. 2005. Cotton in ultra-narrow row spacing: plant density and nitrogen fertilizer rates. *Agron. J.* 97:279-287.

8. Bridge, R.R., W.R.J. Meredith and J.F. Chism. 1973. Influence of planting method and plant population on cotton (*Gossypium hirsutum* L.). *Agron. J.* 65:104-109.
9. Cheema, M.S., M. Akhtar, L. Ali and M. Jamil 2004. Effect of plant density on seed cotton yield of different varieties. *J. Agric. Res.* 42 (3-4):253-259.
10. Chauhan, S.K. 2007. Seeding technique under saline water irrigation for cotton- wheat rotation. *Bhartiya Krishi Anusandhan Patrika.* 22(4):
11. Christiansen, M.N. and R. Rowland. 1981. Cotton Physiology. Vol. 3. Seed and germination. p. 315-318. Proc. Beltwide Cotton Prod. Res. Conf., New Orleans, LA. Jan. 4-8, 1981. Natl. Cotton Council of Am., Memphis, TN.
12. Dong, H., W. Li, W. Tang and D. Zhang. 2008. Furrow seeding with plastic mulching increases stand establishment and lint yield of cotton in saline field. *Agron. J.* 100 (6):1640-1646.
13. Esparza, M.J.H. and A.S. Pedroza. 1997. Effect of plant density and harvesting date on yield and quality of cotton. *ITEA-Production Vegetable.* 93:94-103.
14. Franklin, S., N. Hopper, J. Gannaway and R. Boman. 2000. Effect of various intra- row skips, plant populations, and irrigation levels on development and yield in cotton. p. 604-605. Proc. Beltwide Cotton Conf., San Antonio, TX. Jan. 4-8, 2000. Natl. Cotton Council of Am., Memphis, TN.
15. Gill, M.I. 1999. Bed and furrow planting method ensures profitable seed cotton yield. *The Pak. Cotton Grower.* 3(1):10-11
16. Hussain, T., Jehanzeb, M. Tariq and B.N. Siddiqui, 2003. Effect of different irrigation levels on the yield and yield components of cotton (*Gossypium hirsutum* L.) under two sowing methods. *J. Biol. Sci.* 3:655-659.
17. Iqbal, N., H.M. Nasrullah and C.M.S. Sindhu. 2002. Effect of row spacing on seed cotton yield. *J. Agric. Res.* 40 (3-4):181-185.
18. Jagannathan, N.T. and R. Venkitaswamy. 1996. Effect of plant density and nutrient levels on new cotton varieties. *Madras Agric. J.* 83:159-161.
19. Jones, M.A. and R. Wells. 1998. Fiber yield and quality of cotton grown at two divergent population densities. *Crop Sci.* 38:1190-1195.
20. Khan, K., Z. Mahmood, A.R. Soomro and N. Illahi. 2005. Seed cotton yield as influenced by different plant spacings under D. I. Khan environment. *The Indus Cottons.* 2.
21. 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 Pak. Cottons.* 32 (2):94-100.

22. Khan, S.U. and K. Ullah. 1991. Effect of various planting methods on seed cotton yield. *The Pak. Cottons*. 35 (1):43-47.
23. Kittock, D.L., R.A.Stelley, C.J. Chain and B.B. Tayler. 1986. Plant population and plant height effects on pima cotton lint yield. *Agron. J.* 78:534-538.
24. Muhammad, D., M.M. Anwar, M.S. Zaki and M.N. Afzal. 2003. Effect of plant population and nitrogen variables on cotton crop. *The Pak. Cottons*. 47 (1-2):37-41.
25. Rana, M.A. and S.H. Shah. 1981. Growth and yield performance of four American cotton varieties planted at different inter plant spaces. *The Pak. Cottons*. 25 (2):95-98.
26. Rind, Z.A., G.H. Jamro, A.G. Rajper and G.M. Laghari. 2006. Effect of plant spacing on the growth and yield of cotton. *The Indus Cottons*. 3.
27. Siebert, J.D., A.M. Stewart and B.R. Leonard. 2006. Comparative growth and yield of cotton planted at various densities and configurations. *Agron. J.* 98 (3):562-568.
28. Shah, S.M., M.S.S. Khan, T. Sajjad and W. Malik. 2005. Effect of various plant populations on seed cotton yield and other yield components. *The Indus Cottons*. 2.
29. Soomro, A.R., M.H. Channa, A.A. Channa, G.N. Dayo, G.H. Kalwar and A.H. Memon. 2000. Yield performance of three cotton cultivars under varying plant spacings at Ghotki, Upper Sindh. *The Pak. Cottons*. 44 (2):57-60.
30. Steel, R.G.D. and J.H. Torrie. 1984. *Principles and Procedures of Statistics*. McGraw Hill Book Company, New York. p.187-188.
31. Williford, J.R. 1992. Production of cotton on narrow row spacing. *Trans. ASAE*. 35:1109-1112.