ISSN Print: 2664-844X
ISSN Online: 2664-8458
NAAS Rating: 4.97
IJAFS 2025; 7(5): 43-46
www.agriculturaljournals.com
Received: 12-03-2025
Accepted: 14-04-2025

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Effect of different sowing methods on growth and yield of cotton: A review

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DOI: https://www.doi.org/10.33545/2664844X.2025.v7.i5a.378

Abstract
Cotton (*Gossypium hirsutum* L.) plays a vital role in economy and it is the lifeline of the textile industry in the country. Agronomic practices play a significant role in growth and yield of plant. In various agronomic practices sowing methods play significant role in obtaining good crop yields. To explore the agronomic growth and yield of cotton under different sowing methods the following case studied has been studied. The review paper comprised of various method of sowing. Plant height, number of bolls per plant (opened and unopened), average boll weight (g), number of sympodial and monopodial branches per plant and yield significantly affected by different sowing methods.

Keywords: Cotton, yield sowing methods, seed cotton yield, boll

Introduction
Cotton is one of the most important fibre and cash crop of India and plays a dominant role in the industrial and agricultural economy of the country. There are four cultivated species of cotton *viz. Gossypium arboreum*, *G. herbaceum*, *G. hirsutum* and *G. barbadense*. Among these species the first two is diploid (2n=26) and are native to old world and the last two species are tetraploid (2n=52) and are also referred to as New World Cottons. Lint percentage of cotton is 33% and their fibre maturity is measured by Arealo-meter. Cotton holds a top position as the important global fibre crop, primarily serving the textile industry (Saini *et al.*, 2010; Yadav *et al*., 2017; Yadav *et al*., 2018) [25]. Due to its vital role in agriculture, industrial development and employment generation, it is an important fibre crop of India (Singh *et al*., 2018) [27]. Plant growth and development depends upon favourable soil conditions and sowing method which have suitable soil moisture content, temperature and method or technique of sowing. Therefore, an effective sowing method is required that may use such tillage system which improves the soil physical properties and enhance the germination, plant growth and development as well as yield (Krause *et al.*, 2009) [19]. Cotton plants respond significantly to sowing methods, the uniformity of their distribution over the sowing area, considerably affecting the seed cotton yield and fibre quality traits (Ozpinar and Isik, 2004; Mert *et al.*, 2006; Balkcom *et al*., 2010; Menefee *et al*., 2023) [4, 21, 22, 23]. India has the largest cotton area in the world with about 11 million hectares accounting for one-fourth of the global cotton area. Among many agronomic factors responsible for cotton growth and yield, the planting method has prime importance because it not only helps in establishing the appropriate crop stand but also facilitates the conversion of light energy by balancing plant to plant competition in order to produce maximum crop yield (Ali *et al.* 2012) [2] Based on cotton growing conditions, the sowing methods showed varied responses and effectiveness in production. Therefore, it is crucial to establish the soil and climatic conditions suitable to what type of sowing method to ensure the optimum seed cotton yield. Cotton cultivation on ridges across the slopes conserves more water, reduces soil erosion and improves yield. Among many agronomic factors responsible for cotton growth and yield, the planting method has prime importance because it not only helps in establishing the appropriate crop stand but also facilitates the conversion of light energy by balancing plant to plant competition in order to produce maximum crop yield (Ali *et al.* 2012) [2].

The placement of seed at correct depth is very important for proper germination and for obtaining optimum plant population per unit area of the crop especially under dry land farming where soil moisture is at greater depth (Khambalkar *et al*., 2010) [17].

Cotton-wheat cropping system is the most prevalent cotton-based system in Punjab (Singh *et al*., 2019) [28], in which cotton is raised during summer season (Singh *et al*., 2018) [27]. Anwar *et al.* (2003) [3] reported that 33% higher seed cotton yield was observed from bed-furrow planting as compared with flat planting. Similarly, Hussain *et al.* (2003) [14] 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 (Boquet *et al*. 2005) [5].

Discussion

Irfan *et al* (2020) [16] studied an experiment which comprised of two tillage systems *viz* conventional tillage (one-time disc harrow + two cultivations + planking) and deep tillage (chiseling twice + one cultivation + planking) along with three sowing methods *viz* flat sowing, ridge sowing and bed sowing. The result showed that the bed sowing exhibited higher yield contributing traits such as number of opened bolls per plant and boll weight as compared to ridge and flat sowing.

Effect on different method of sowing on yield of cotton

Makhmadjanov *et al.* (2025) [20] evaluated an experiment to check the effect of sowing methods on fibre yield and quality parameters of the upland cotton and founds that the two-line sowing method with plant spacing (80×11×2×10×1) and plant density (200,000 ha-1) contributed to an increase in the seed cotton yield (4.76 t/ha). The highest seed cotton yield could refer to the topmost plant density and the largest number of bolls per unit area, which were 32%-33% more than the traditional cotton sowing technology. In an experiment of different planting method pit planting, bed planting, ridge planting and line sowing with varied inter row spacing observed that the cotton seed weight was not affected significantly by different sowing methods while maximum seed cotton yield (2944.5 kg ha) was produced by flat sowing (Ehsanullah *et al.* 2017) [12].

Ali and Ehsanullah *et al*. (2007) [1] 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% higher seed cotton yield in cotton-wheat rotation (Chauhan *et al.* 2007) [6]. Similarly furrow-bed seeded cotton increased lint yield by 25% compared with flat seeded cotton (Dong *et al.*, 2008) [11].

Field experiment was conducted to study the growth, productivity and quality and root characteristics of Bt. Cotton under different planting methods *viz*. T_1: Cotton sowing drill (Three Tynes), T_2: Cotton sowing drill (Four Tynes), T_3: Ridge sowing and T_4: Bed maker. It was observed that the bed maker Bt sowing machine treatment gave significantly higher cotton yield (12.3%) over cotton sowing drill (Three Tynes) but it was statistically similar with ridge sowing (Dhillon *et al*. 2019) [9]. On the basis of results of two-year field experimentation, it is concluded that Bt cotton can be raised with preparing the field by ploughing followed by blade harrowing & planking and sow the crop on ridge for achieving higher yield and net realization.

Fig 1: Bed Planter

Fig 2: Ridge planter

It has been observed from the experiments that treatment T_1 (Pusa 1121 +line sowing) showed the best values as compared to all the other treatments. The method of sowing shows the significant impact on the growth and yield parameters as depicted on the final yield. Treatment T_4 (Basmati 1509 + line sowing) also showed similar results which may be due the positive varietal difference with different sowing methods. Further, the molecular level research may be required to evaluate the variety and yield correlations.

A field experiment was conducted to assess the effect of different methods and weed management practices on seed cotton yield. The experiment comprised of six sowing methods *viz*. Flat sowing by drill and weeding twice, Flat sowing and each row earthing up, Flat sowing and alternate row earthing up, dibbling on both sides of bed at proper moisture regime and weeding twice, dibbling on both sides of bed in dry condition and followed by irrigation and weeding

twice and planting in flat and mulching up Flat sowing by drill and every row earthing up proved to be the best sowing method by giving maximum seed cotton yield of 3542 kg ha^{-1} with minimum weed density of only 12 plants m^{-2} and biomass of 10 g $^{m-2}$ (Cheema *et al.* 2008) [7]. Whereas in an experiment which was conducted to evaluate the effect of three cotton planting patterns at five plant densities on cotton growth, yield, and fibre quality noted that planting pattern did not influence any plant structure or yield variables, seed cotton or lint yield, lint percentage, lint or seed index, and fibre quality (Stephenson and Barber 2011) [29]. Ridge sowing of cotton has been found to improve the soil physical properties such as increased soil moisture content and decreased root penetration resistance and also enhances the emergence and seed cotton yield (Gursoy *et al*. 2011) [35].

Effect of different sowing methods on growth factor of cotton plant

Ehsanullah, *et al.* (2017) [12] conducted an experiment with treatment combination of different sowing methods including pit planting (1 m × 1 m pits), bed planting (75 cm apart beds), ridge planting (75 cm apart ridges) and line sowing with varied inter row spacing (R × R) *viz*. 25, 50 and 75 cm. It was observed that the highest plant height (152.0 cm) was observed when the crop was sown in pits. Whereas, lowest plant height (119.6cm) was observed in ridge planting and flat planting. In an experiment Dhillon *et al*. (2019) [9] founds that the Bed maker Bt sowing machine treatment resulted highest plant height (204.2cm) and dry matter accumulation but were statistically at par with ridge sowing (202.1cm) and significantly higher than other planting methods.

Fig 3: Flat Bed sowing

Nadeem *et al* (2013) evaluated that among sowing methods, ridge sowing was the better method in terms of increasing monopodial (2.99) and sympodial branches per plant (21.87), plant height (143.98cm) total number of bolls per plant (32.18), number of mature bolls per plant (30.82), seed cotton weight (3.4g) and seed cotton yield (13.28 Kg per hec) as compare to flat sowing.

A field experiment was studied to evaluate the influence of different sowing methods and planting densities on growth, yield, quality and economic returns of cotton. Sowing methods included pit planting (1 m × 1 m pits), bed planting (75 cm apart beds), and ridge planting (75 cm apart ridges). Sowing methods significantly affected growth and yield of cotton. Pit planting imposed maximum increase in plant height (152 cm), number of monopodial branches (4.7) and sympodial branches (22.6) per plant, number of unopened (9.4) and opened bolls (41.1) per plant, and average boll weight (3.0 g) of cotton (Ehsanullah *et al* 2017) [12].

Khan *et al* (2012) [18] conducted a study to evaluate the effects of planting methods on root development, crop allometry, water use efficiency (WUE), productivity and economic returns of different maize (*Zea mays* L.) different planting methods includes beds, ridges, and flat sowing. Ridge sowing was better followed by bed sowing. Well-developed root system, with longer primary root, a greater number of lateral roots and higher root growth rate planted on ridges, which led to higher productivity (5.45 t ha^{-1}) and WUE (1.345 kg m^{-2}), in all the maize hybrids. There was a significant effect of different sowing methods on the lint index of cotton. Highest lint index was observed when the crop was sown with bed maker Bt sowing machine but it was statistically at par with ridge sowing and significantly higher than other plant methods during both the years (Dhillon BS, *et al*., 2019) [9].

Conclusion

Sowing method play a significant role in growth and yield of the crop. According to the result the yield and growth of the plant greatly influenced by different sowing method. Among the different sowing methods every method plays their own role like ridge-furrow and bed sowing effect growth and yield by increasing water use efficiency and less weed competition, line to line sowing and broadcasting method effect by effecting plant population. However, the growth and yield of the plant highly affected by the bed and ridge sowing method followed by pit planting as compare to the other method of sowing.

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