Mechanized cotton picking in narrow rows under Greek conditions

D.I. Bartzialis and S. Galanopoulou-Sendouca
University of Thessaly, Department of Agriculture, Crop Production and Agricultural Environment, Volos GREECE
Correspondence author dbartz@uth.gr

ABSTRACT

Cotton is traditionally cultivated in rows 1 m apart. This system was imposed by the early picker machines, which are adjusted to pick at such distances. Many field experiments showed the superiority of narrow rows, regarding yield, earliness and low input use. The adoption of new cotton pickers, which may collect cotton either in 1 m or 0.75 m, allows the fully mechanized application of narrow rows. This mechanized system first commenced evaluation in Greece in 1997. A field experiment was carried out in two different locations in Thessaly, Greece, for three years. The growth and development of two main Greek cotton cultivars (Corina and Zeta-2) were studied for three plant populations (10, 20 and 30 plants/m^2) and two sowing row-distances (0.75 m and 1 m), in a split-split plot design with five replications. The results showed superiority of narrow-row cotton regarding yield, and number of flowers and bolls. In addition, the plants in narrow-rows were smaller and more compact, but leaf area index was greater, because of the earlier canopy closure, and higher biomass. Ten plants per m^2 yielded more than both higher populations in both row distances. No significant differences were found for cotton-quality characteristics between row distances and plant populations.

Introduction

The mechanized cotton cultivation in rows narrower than the conventional 1 m row spacing is a promising method especially after the newly developed picker technology, which permits cotton harvesting in row distances either 1 m or 0.75 m. Narrow row cultivation and dense populations of cotton are two subjects, which have been studied by many researchers (Galanopoulou *et al.*, 1980; Williford, 1992; Heithold *et al.*, 1993). According to research data, in the USA, cotton cultivation in narrow rows (0.75 m) increases yield by 6.5-14% (Williford, 1992). This yield increase is attributed to the greater exploitation of solar energy and other inputs due to an improved distribution of plants in narrower than conventional rows (Robinson, 1991). Other possible advantages mentioned include greater light interception and better light distribution within canopy, faster canopy closure and increased plant population (Krieg, 1992). The objective of this study is to evaluate, for the first time in Greece, the growth and development of cotton grown in 0.75 m rows, under fully mechanized conditions.

Experimental procedure

A field experiment was conducted at two locations in central Greece in three years (1997 to 1999). The sites, representative of major cotton production areas in the country, are: a) Stefanovikio, Magnesia (farmer's field), and b) Palamas, Karditsa (National Agricultural Research Foundation). The experiment was a 2 x 2 x 3 factorial, arranged in a split-split plot design with five blocks. Main plots were the two row spacings: 1 m and 0.75 m, subplots were two cultivars: Zeta2 and Corina, and sub-subplots were three plant populations: 10, 20 and 30 plants/m^2. A plot consisted of four rows of length of 65 m at Stefanovikio and 40 m at Palamas.

The usual cultural practices were applied for the experiments. Planting took place in the last 10 days of April, with a precision sowing machine. Harvesting includes two hand picking areas per plot of 10 linear meters of cotton and one mechanical picking, in the rest of the plot, by a 4-rows cotton picker (Case IH 2055, for Stefanovikio and John Deere 9960, for Palamas), for both row distances, appropriately adjusted.

Flowering measurements (from first of July to middle of August) and growth analysis (based on five samples every 20 days during the growing period) were carried out, at both sites. Additionally, fiber quality characteristics were analyzed. Experimental results were statistically processed using computer software (Microsoft Excel and MSTAT).

Results

The combined results for locations and years for plant characteristics, fiber quality and yield are shown in Figures 1 to 5 and Tables 1 and 2. Conventional and narrow-row cotton plants had similar height at the flowering initiation period but at the end of cultivation period plants, the 1 m rows were taller than those of 0.75 m (Figure 1) due to greater internode length (Figure 2). Plants in narrow rows entered flowering period with greater biomass and Leaf Area Index (LAI) compared to conventional rows, and these differences were maintained during the growing season (Figures 3 and 4). Row spacing did not significantly influence fiber properties (Figure 5). Narrow row cottons produced significantly higher number of flowers and bolls (Table 1) and yielded significantly more than conventional row cottons (Table 2). Varietal yield results were presented in previous work (Bartzialis and Galanopoulou-Sendouca, 2002). The population of 10 plants/m^2 was proved significantly superior than the others regarding number of flowers and bolls, as well as lint yield in both row distances (Tables 1 and 2).

Discussion and Conclusions

At the beginning of the flowering period, plants at both spacings had the same height, probably because of the absence of competition but later on, the plants in conventional rows became taller. This is in accordance with previous results (McConnell *et al*., 1995). Total biomass production and LAI were significantly greater in the 0.75 m rows compared to the conventional rows from early season. Similar results were reported by Staggenborg (1992). According to other researchers, positive relationship between early-season LAI and lint yield was reported (Wells and Meredith, 1986).

Row spacing did not affect the major fiber properties and these results are in accordance with numerous studies (Baker, 1992; Heitholt, 1993). Numbers of flowers and bolls as well as lint yield were significantly higher in the 0.75 m row spacing than in the 1 m. The average yield increase for narrow rows in comparison to conventional was 9.3%. These results are in accordance to those in previous studies (Robinson, 1991; Krieg, 1992; Williford, 1992). The yield superiority in narrow rows may be partially attributed to the greater LAI in the early season as it was found in other studies (Wells and Meredith, 1986). The higher efficiency of 10 plants/m^2 compared to more dense populations in both row distances indicates that the spatial distribution of plants is the main factor to yield increases. According to Williford (1992), uniformity of stand is probably more important than actual population for populations greater than 7.5 plants/m^2. In contrast, other studies reported that dense populations, increased yield (Baker, 1976; Galanopoulou-Sendouca, 2002).

References

- Baker, S.H. (1976). Response of cotton to row patterns and plant populations. *Agronomy Journal*, **68**: 85-88.
- Baker, S. H. (1992). Response of different plant types to row spacing. Proceedings of Beltwide Cotton Conferences. National Cotton Council of America, TN., pp. 605.
- Bartzialis, D.I. and Galanopoulou-Sendouca, S. (2002). Study of two cotton varieties in narrow rows under mechanized picking. Abstracts of 9th National Conference of Plant Breeding and Genetics. Thessaloniki, 30 Oct. – 1 Nov. (in Greek).
- Galanopoulou-Sendouca, S., Sficas, A.G., Fotiadis, N.A., Gagianas, A.A. and Gerakis, P.A. (1980). Effects of population density, planting date and genotype on plant growth and development of cotton. *Agronomy Journal*, **72**: 347-353.
- Galanopoulou-Sendouca, S. (2002). Industrial Plants. Edit. Ath. Stamoulis. Athens, Greece. pp: 107 (in Greek).
- Heitholt, J.J., Pettigrew, W.T. and Meredith, W.R. (1993). Growth, boll opening rate and fiber properties of narrow-row cotton. *Agronomy Journal*, **85**: 590-594.
- Krieg, D.R. (1992). Narrow-row cotton production in marginal environments. Proceedings of Beltwide Cotton Conferences. National Cotton Council of America, TN., pp: 136-138.
- Mc Connell, J.S., Vories, E.D., Frizzell, B.S. and Glover, R.E. (1995). Production and economic studies of 30-inch conventional row spaced cotton. Summaries of Cotton. Summaries of Cotton Researching Progress. *Arkansas Experiment Station Special Report* **172**: 95-99.
- Robinson, E. (1991). The development of the first narrow-row picker involves more than just row spacing. *Cotton Grower*, **July**: 12-13.
- Staggenborg, S.A., Krieg, D.R. and Harris, J.L. (1992). Water, nitrogen, and radiation use efficiency of cotton production systems. Proceedings of Beltwide Cotton Conferences. National Cotton Council of America, TN., pp. 1029-1030.
- Wells, R. and Meredith, W.R. Jr. (1986). Heterosis in upland cotton. I. Growth and leaf area partitioning. *Crop Science,* **26**: 1119-1123.
- Williford, J. (1992). Production of cotton on narrow-row spacing. *Transaction of the ASAE,* **35**: 1109-1111.

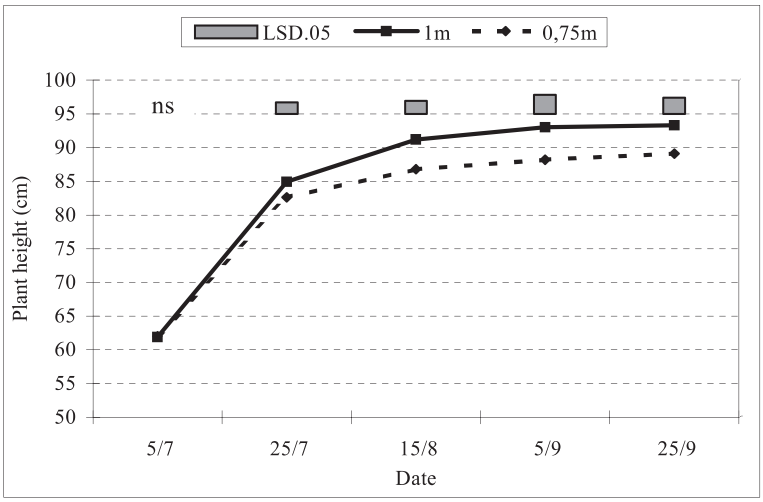

Figure 1. *Cotton plant height (cm) in conventional (1 m) and narrow (0.75 m) rows.*

Figure 2. *Mainstem nodes in conventional (1 m) and narrow (0.75 m) rows.*

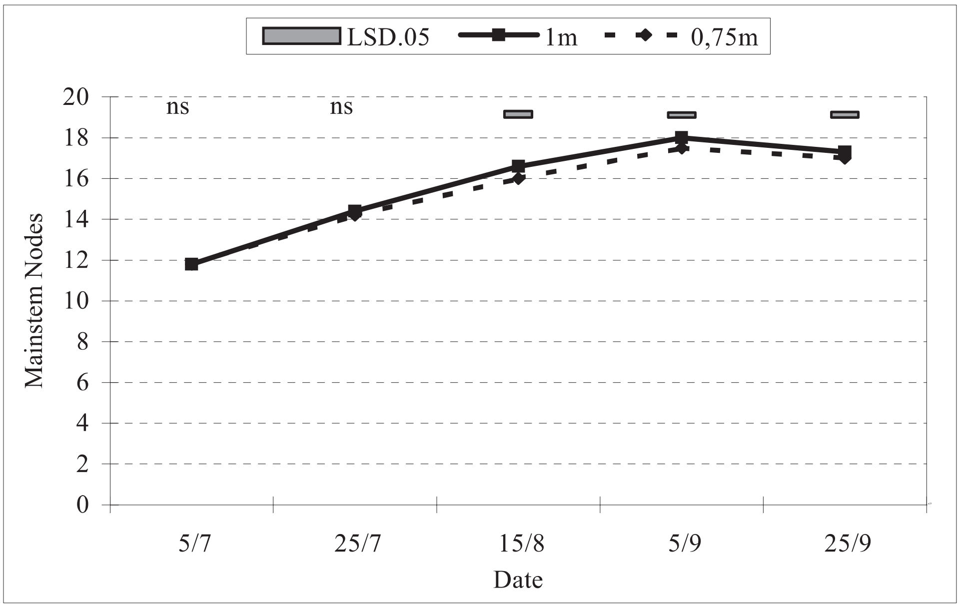

Figure 3. *Biomass (g/m²) in conventional (1 m) and narrow (0.75 m) rows.*

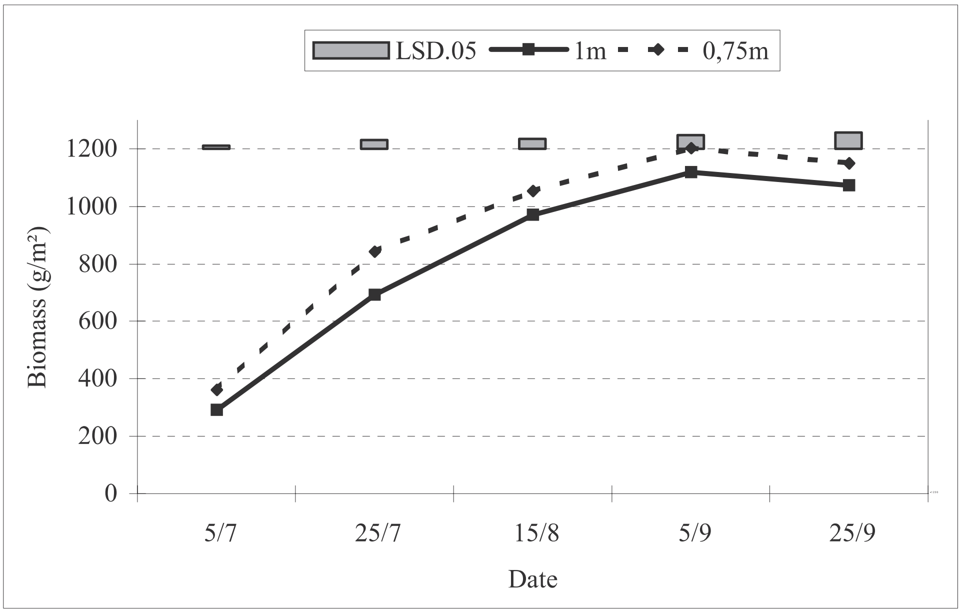

Figure 4. *Leaf area index in conventional (1 m) and narrow (0.75 m) rows.*

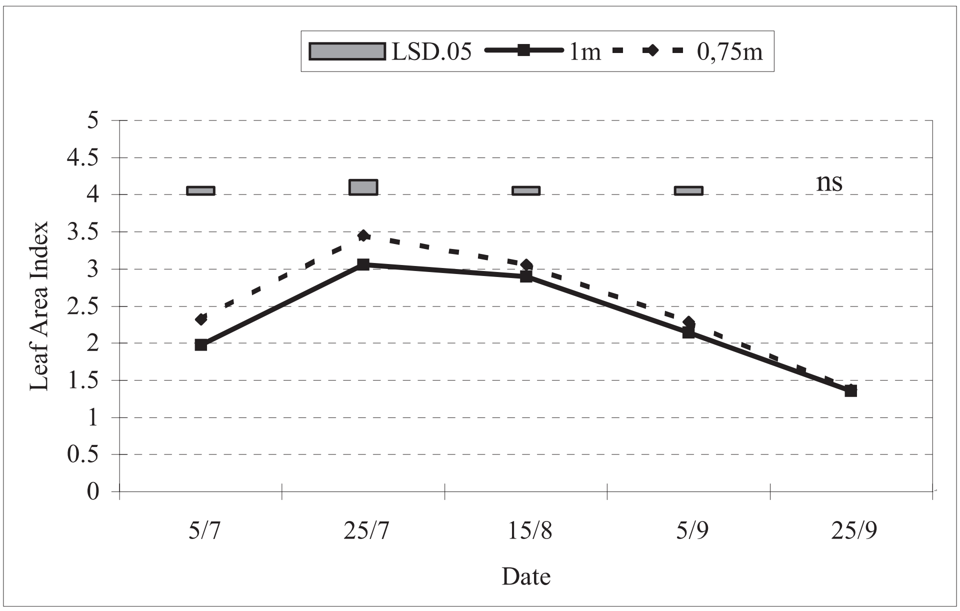

Figure 5. *Cotton quality characteristics in conventional (1 m) and narrow (0.75 m) rows.*

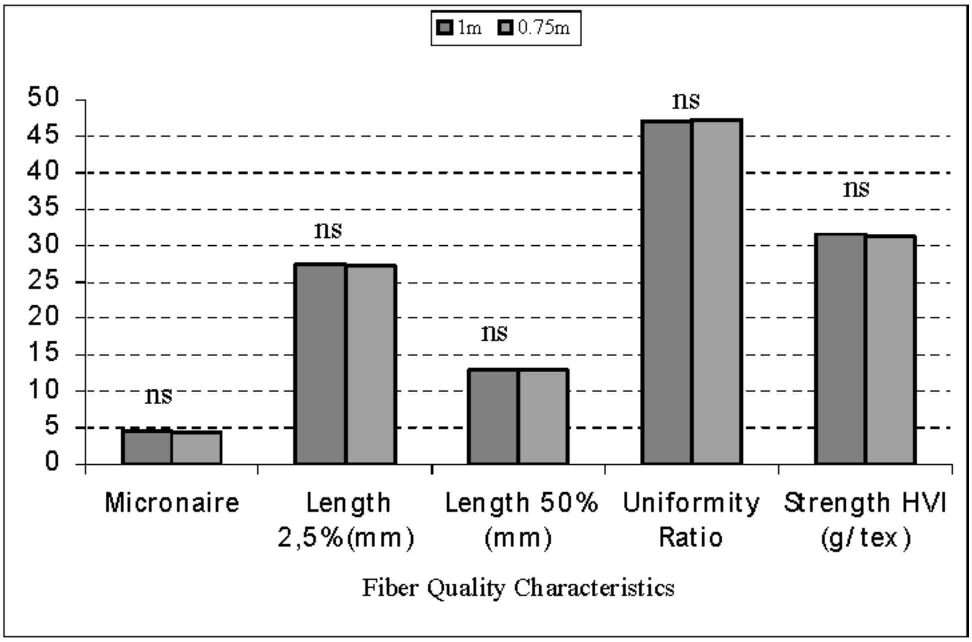

Table 1. *Total number of flowers and bolls per m².*

	Flowers/m²	Bolls/m²
1m	119	62.4
0.75m	133	68.9
LSD $_{0.05}$	*3.1*	*1.4*
10 plants/m²	132	64.9
20 plants/m²	126	65.8
30 plants/m²	120	66.3
LSD $_{0.05}$	*3.8*	*ns*
1m – 10 plants/m²	114	61.1
1m – 20 plants/m²	112	62.8
1m – 30 plants/m²	104	63.4
0.75m – 10 plants/m²	150	68.7
0.75m – 20 plants/m²	139	68.9
0.75m – 30 plants/m²	135	69.2
LSD $_{0.05}$	*ns*[*]	*ns*
CV (%)	*13.32*	*10.17*

[*]*ns* = non significant

Table 2. *Lint cotton yield (kg/ha).*

	Lint cotton (kg/ha)
1m	1557
0.75m	1702
$LSD_{0.05}$	*37.5*
10 plants/m²	1676
20 plants/m²	1623
30 plants/m²	1590
$LSD_{0.05}$	*41.5*
1m – 10 plants/m²	1602
1m – 20 plants/m²	1544
1m – 30 plants/m²	1526
0.75m – 10 plants/m²	1750
0.75m – 20 plants/m²	1701
0.75m – 30 plants/m²	1654
$LSD_{0.05}$	[*] *ns*
CV (%)	*10.02*

[*] *ns* = non significant