



Impact of new varieties and intercropping of pulses on productivity and economics of cotton

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Abstract : Sixty Front Line Demonstrations (FLDs) on cotton intercropping with pulses were carried out in a total 60 hectares of 61 farmers' fields in 23 villages in Madurai, Virudhunagar and Thoothukudi Districts of Southern Tamil Nadu during winter irrigated or rainfed seasons (August 2018 to January 2017-2018, 2018-2019 and 2019-2020). The FLD on cotton intercropping with black gram and green gram were compared with farmers' practice. In FLD, latest cotton varieties (SVPR 4, SVPR 5 and CO 17), black gram (VBN 6, VBN 8 and MDU 1) and green gram (CO 8) intercropping, balanced fertilizer application and integrated pest management practices were adopted. In farmers' practice, use of mixed varieties, broadcasting, without intercropping, unbalanced fertilizer application and irregular use of insecticides were followed. The results revealed that adoption of improved varieties and integrated management practices recorded higher mean *kapas* yield of 2160 and 1583 kg/ha under irrigated and rainfed conditions, respectively as compared to farmers method of cultivation (1836 and 1403 kg/ha). Thus the yield advantage of 17.58 and 13.02 per cent under irrigated and rainfed conditions, respectively than control was observed. Among the varieties, CO 17 performed better than other varieties during all the years of study. The Land Equivalent Ratio was more than one indicating the higher efficiency of yield production of cotton with intercropping of pulses than sole cotton. Higher mean net profit of Rs 52,760/ha and Rs 36,298/ha under irrigated and rainfed conditions respectively were associated with the use of high yielding varieties and improved production technologies (Rs 29,165 and 20,674/ha) and higher benefit cost ratio than farmers' practice. Thus cultivation of new varieties with improved production technologies gained an additional economic benefit of Rs. 28,642 and 16,895/ha as compared to existing varieties with farmers' method. It can be concluded from the Front Line Demonstrations that adoption of modern varieties of cotton with intercropping lead higher yield, better land use efficiency and higher economic benefits which will pave way for sustainable cotton production.

Keywords : Cotton, economics, intercropping, land equivalent ratio, seed cotton yield

Cotton also known as "White Gold" is an important fibre cum cash crop in India and Tamil Nadu as well. The contribution of India to global cotton fibre and edible oil production is 44 and 10 per cent, respectively. India has the largest area (41.3 %) of cotton in the world, but, due to its lower productivity, its share to the total world cotton production is only 25.4 per cent. In Tamil Nadu, cotton is cultivated in an area of 1.55 lakh ha during 2020-2021 with a production of 5.0 lakh bales and productivity of 548 kg/ha, which is below the world average yield of 768 kg/ha (Anonymous, 2021). In order to meet the demand and to satisfy the native mill requirement of cotton, the productivity should be increased. Intercropping has been

recognized as potentially beneficial and economic system of crop production. It is the only way to increase the cropping intensity and resource utilization for efficient management of inputs. The main objective of intercropping is to obtain an additional yield or to realize higher total economic returns and also to minimize the risk. There is ample scope and greater potential to increase the productivity of cotton through effective transfer of technologies. The production technologies meant for increasing production need to be demonstrated in the farmer's field. This will pave way for sustainable cotton production and improve the standard of living of farming community.

MATERIALS AND METHODS

Sixty Front Line Demonstrations (FLDs) on cotton intercropping with pulses were carried out in 60 hectares of 61 farmers' fields in 23 villages in Madurai, Virudhunagar and Thoothukudi Districts of Southern Tamil Nadu during winter irrigated or rainfed seasons (August 2018 to January 2017-2018, 2018-2019 and 2019-2020). The FLD on cotton intercropping with black gram and green gram were compared with farmers' practice. In FLD, latest cotton varieties (SVPR 4, SVPR 5 and CO 17), black gram (VBN 6, VBN 8 and MDU 1) and green gram (CO 8) intercropping, balanced fertilizer application and integrated pest management practices were adopted. In farmers' practice, use of mixed varieties, broadcasting, without intercropping, unbalanced fertilizer application and irregular use of insecticides were followed. The details of demonstrations are furnished in Table 1. The fertilizer application as per the blanket recommended dose for cotton (80 : 40 : 40 kg NPK/ha) were applied. The *kapas* yield were recorded and economics were worked out. The varietal performance and cotton equivalent

yield were also analyzed. The land equivalent ratio (LER) was calculated for both sole crops and intercropping systems.

RESULTS AND DISCUSSION

Seed cotton yield

The results revealed that the seed cotton yield was substantially increased due to adoption of improved varieties and intercropping (Table.2). Averaging over locations, adoption of improved varieties and integrated management practices registered meankapas yield of 2013, 2025 and 2441 kg/ha under irrigated and 1481, 1493 and 1620 kg/ha under rainfed conditions respectively during 2017-2018, 2018-2019 and 2019-2020 as compared to farmers method of cultivation (1775, 1777 and 1956 kg/ha under irrigated and 1251, 1337 and 1620 kg/ha under rainfed conditions, respectively). The mean *kapas* yields over the three years of study under FLD were 2160 and 1583 kg/ha under irrigated and rainfed conditions respectively than farmers practice (1836 and 1403 kg/ha). Thus the mean yield advantage under irrigated and rainfed conditions were 17.58 and 13.02 per cent, respectively than control was observed. The

Table 1. Details of field demonstrations in the study area

| S. No | Particulars | 2017-2018 | 2018-2019 | 2019-2020 | Total |
|-------|-----------------------------|--|--|--|-------|
| 1 | Area of demonstrations (ha) | 20 | 20 | 20 | 60 |
| 2 | Number of farmers | 21 | 20 | 20 | 61 |
| 3 | Number of villages | 9 | 9 | 5 | 23 |
| | No of districts covered | 3 | 2 | 2 | 7 |
| 4 | Name of the villages | VirudhunagarDt: Puliparaipatti , A.Subramaniyapuram, Melapalayapuram and Iluppaiyoor MaduraiDt: Thummakundu, P.Subbalapuram, M.Subbalapuram and V.Redrapatti ThoothukudiDt : C. Kumareddaiapuram | VirudhunagarDt: P.Thiruvengadapuram, Pattakulam, Rengapalayam, Vaithilingapuram, Melakodangipatti, Sithalamputhur, A.Subramaniyapuram and Sundarapandiam MaduraiDt :Sivarakottai | VirudhunagarDt: Sithalamputhur, Athikulam and Nathampatti ThoothukudiDt: Ilayarasanenthal and Puliangulam | - |
| 5. | Cotton varieties used | SVPR 2 , SVPR 5 and CO 17 | SVPR 4 , SVPR 5 and CO 17 | SVPR 6CO 17 | - |
| 6. | Pulses varieties used | Blackgram (MDU 1, VBN 6) and Green gram (CO 8) | Black gram Vamban 8 | Black gram Vamban 6 and Vamban 8 | - |

Table 2. Impact of intercropping on yield and economics of cotton

| S. No. | Particulars | Method of cultivation | 2017-2018 | | 2018-2019 | | 2019-2020 | | Mean | |
|--------|--------------------------------------|-----------------------|--------------|------------------|--------------|------------------|--------------|------------------|--------------|------------------|
| | | | FLD | Farmers practice | FLD | Farmers practice | FLD | Farmers practice | FLD | Farmers practice |
| 1 | Seed cotton yield (kg/ha) | Irrigated | 2013 | 1775 | 2025 | 1777 | 2441 | 1956 | 2160 | 1836 |
| | | Rainfed | 1481 | 1251 | 1493 | 1337 | 1775 | 1620 | 1583 | 1403 |
| | | Mean | 1747 | 1513 | 1759 | 1557 | 2108 | 1788 | 1871 | 1619 |
| 2 | Per cent yield increase by FLD | Irrigated | 13.98 | - | 13.96 | - | 24.79 | - | 17.58 | - |
| | | Rainfed | 18.37 | - | 11.74 | - | 8.95 | - | 13.02 | - |
| | | Mean | 16.18 | - | 12.86 | - | 17.90 | - | 15.65 | - |
| 3 | Mean yield of intercrop (kg/ha) | Irrigated | 280 | - | 198 | - | 150 | - | 209 | - |
| | | Rainfed | 150 | - | 119 | - | 118 | - | 129 | - |
| | | Mean | 215 | - | 159 | - | 134 | - | 169 | - |
| 4 | Cost of cultivation (Rs/ha) | Irrigated | 44000 | 38000 | 52000 | 48000 | 54000 | 49000 | 50000 | 45000 |
| | | Rainfed | 40000 | 32000 | 42000 | 40000 | 43000 | 40000 | 41667 | 37333 |
| | | Mean | 42000 | 35000 | 47000 | 44000 | 48500 | 44500 | 45834 | 41167 |
| 5 | Net income (Rs/ha) | Irrigated | 54016 | 29600 | 51446 | 32219 | 54317 | 25675 | 52760 | 29165 |
| | | Rainfed | 38975 | 20560 | 33084 | 21522 | 36835 | 19940 | 36298 | 20674 |
| | | Mean | 46496 | 25080 | 42265 | 26871 | 45576 | 22808 | 44530 | 24197 |
| 6 | Additional net income by FLD (Rs/ha) | Irrigated | 24584 | - | 19227 | - | 19642 | - | 28642 | - |
| | | Rainfed | 18415 | - | 11562 | - | 9815 | - | 16895 | - |
| | | Mean | 21500 | - | 15395 | - | 14729 | - | 22769 | - |
| 7 | Benefit Cost Ratio | Irrigated | 2.23 | 1.99 | 1.99 | 1.70 | 2.01 | 1.63 | 2.07 | 1.77 |
| | | Rainfed | 1.72 | 1.55 | 1.78 | 1.54 | 1.86 | 1.50 | 1.79 | 1.53 |
| | | Mean | 1.98 | 1.77 | 1.89 | 1.62 | 1.94 | 1.56 | 1.90 | 1.65 |

Sale price of *kapas* was Rs 42/kg, Rs 45/kg and Rs 37/kg during 2017-2018, 2018-2019 and 2019-2020, respectively

higher yield under FLD was due to adoption of intercropping and also improved production and integrated pest management practices. Intercropping of pulses might have complimentary effect on cotton and thus higher seed cotton yield was observed under intercropping of cotton with pulses. Similar higher yield of cotton intercropping than farmers' practice at Ramanathapuram district of Tamil Nadu was reported by Veeraputhiran *et al.*, (2017). The results of higher seed cotton yield with cotton intercropping as observed by Rami Reddy and Sheik Mohammed (2009), Satish *et al.*, (2012) and Pandagale *et al.*, (2019) are also in favour of this present investigation.

Economic analysis

The economic analysis of both the method of cotton cultivation showed that adoption of intercropping in cotton showed a favorable influence on all the economic

indicators (Table.2). The cost of cultivation was lesser under farmers practice than FLD both under irrigated and rainfed situations which was due to use of local varieties, without intercrop and lesser use of fertilizers. Averaging over locations, higher net profit was observed with FLD than conventional method. Higher mean net profit of Rs. 52,760/ha and Rs 36,298/ha under irrigated and rainfed conditions respectively were associated with the use of high yielding varieties and improved production technologies than farmers practice (Rs. 29,165 and 20,674/ha). Higher net income due to higher grain yield resulted in additional economic benefit under FLD. Thus, cultivation of new varieties with improved production technologies gained an additional economic benefit of Rs. 28,642 and 16,895/ha as compared to existing varieties with farmers' method of cultivation. Irrespective of varieties and irrigated or rainfed

Table 3. Performance of varieties of cotton under FLD

| S. No | Particulars | Method of cultivation | 2017-2018 | | | 2018-2019 | | | 2019-2020 | |
|-------|-----------------------------|-----------------------|--------------|--------------|--------------|--------------|----------------|----------------|--------------|--------------|
| | | | SVPR 2 | SVPR 5 | CO 17 | SVPR 4 | SVPR 5 | CO 17 | SVPR 6 | CO 17 |
| 1 | Seed cotton yield (kg/ha) | Irrigated | 1975 | 2050 | 2160 | 2050 | 2000 | 2140 | 2250 | 2340 |
| | | Rainfed | 1449 | 1471 | 1523 | 1502 | 1465 | 1563 | 1752 | 1816 |
| | | Mean | 1712 | 1761 | 1842 | 1776 | 1733 | 1852 | 2001 | 2078 |
| 2 | Cost of cultivation (Rs/ha) | Irrigated | 44000 | 44000 | 44000 | 52000 | 52000 | 52000 | 49000 | 49000 |
| | | Rainfed | 40000 | 40000 | 40000 | 42000 | 42000 | 42000 | 40000 | 40000 |
| | | Mean | 42000 | 42000 | 42000 | 47000 | 47000 | 47000 | 44500 | 44500 |
| 3. | Total income (Rs/ha) | Irrigated | 82950 | 86100 | 90720 | 92250 | 90000 | 96300 | 83250 | 86580 |
| | | Rainfed | 60858 | 61782 | 63966 | 67590 | 65925 | 70335 | 64824 | 67192 |
| | | Mean | 71904 | 73941 | 77343 | 79920 | 77962.5 | 83317.5 | 74037 | 76886 |
| 4 | Net income (Rs/ha) | Irrigated | 38950 | 42100 | 46720 | 40250 | 38000 | 44300 | 34250 | 37580 |
| | | Rainfed | 20858 | 21782 | 23966 | 25590 | 23925 | 28335 | 24824 | 27192 |
| | | Mean | 29904 | 31941 | 35343 | 32920 | 30962.5 | 36317.5 | 29537 | 32386 |
| 5 | Benefit Cost Ratio | Irrigated | 1.89 | 1.96 | 2.06 | 1.77 | 1.73 | 1.85 | 1.70 | 1.77 |
| | | Rainfed | 1.52 | 1.54 | 1.60 | 1.61 | 1.57 | 1.67 | 1.62 | 1.68 |
| | | Mean | 1.71 | 1.75 | 1.83 | 1.69 | 1.65 | 1.76 | 1.66 | 1.73 |

Table 4. Impact of FLD on cotton equivalent yield and Land Equivalent Ratio in cotton

| S. No | Particulars | 2017-2018 | | 2018-2019 | | 2019-2020 | | Mean | |
|-------|--|-----------|---------|-----------|---------|-----------|---------|-------------|-------------|
| | | Irrigated | Rainfed | Irrigated | Rainfed | Irrigated | Rainfed | Irrigated | Rainfed |
| 1. | Seed cotton yield of FLD(kg/ha) | 2013 | 1481 | 2025 | 1493 | 2441 | 1775 | 2160 | 1583 |
| 2. | Grain yield of intercrop (kg/ha) under FLD | 280 | 150 | 198 | 119 | 150 | 118 | 209 | 129 |
| 3. | Cotton equivalent yield of intercrop (kg/ha) | 347 | 186 | 246 | 148 | 243 | 191 | 279 | 175 |
| 4. | Total cotton equivalent yield (kg/ha) under FLD | 2360 | 1667 | 2271 | 1641 | 2684 | 1966 | 2439 | 1758 |
| 5. | Seed cotton yield under farmers practice (kg/ha) | 1775 | 1251 | 1777 | 1337 | 1956 | 1620 | 1836 | 1403 |
| 6 | Land Equivalent Ratio under FLD | 1.29 | 1.21 | 1.23 | 1.17 | 1.26 | 1.12 | 1.26 | 1.13 |
| 7. | Land Equivalent Ratio under Farmers' practice | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

Sale price of pulses grain were Rs 52/kg, Rs 56/kg and Rs 60/kg during 2017-18, 2018-19 and 2019-20 respectively

cultivation, the mean benefit cost ratio was also higher with FLD (2.07 and 1.79 under irrigated and rainfed conditions respectively) as compared to farmers' practice of cultivation (1.77 and 1.53). Higher economic benefits under cotton intercropped with pulses as noticed by Patel *et al.*, (2013) and Pandagale *et al.*, (2019) are in accordance with the present study.

Varietal performance

The performance of different cotton varieties under FLD in the study area (Table 3) indicated that CO 17 performed better than other varieties during all the years of study. The

compact variety CO 17 registered mean seed cotton yield of 1842, 1852 and 2078 kg/ha, respectively during 2017-2018, 2018-2019 and 2019-2020 than SVPR 2 (1712 kg/ha during 2017-2018), SVPR 4 (1776 kg/ha during 2018-2019) and SVPR 5 (1761 and 1733 kg/ha during 2017-2018 and 2018-2019, respectively) and SVPR 6 (2001 kg/ha during 2019-2020). The variety SVPR 5 produced higher yield than SVPR 2 during 2017-2018 and SVPR 4 out yielded SVPR 5 during 2018-2019. Irrespective of years of study and situations of study (irrigated and rainfed), higher total income, net income and benefit cost ratio were observed in CO 17 followed

by SVPR 5 during 2017-2018 and SVPR 4 during 2018-2019 and SVPR 6 during 2019-2020. Higher economic benefits in the varieties were due to the resultant corresponding higher yield by the respective varieties.

Cotton equivalent yield and land equivalent ratio

The total cotton equivalent yield was higher under FLD than farmers practice (Table.5). Averaging over locations and years, mean cotton equivalent yield under FLD was 2439 and 1758 kg/ha under irrigated and rainfed conditions, respectively. However, farmers practice recorded 1836 and 1403 kg/ha only under irrigated and rainfed conditions, respectively. Thus, 32.84 and 25.30 per cent cotton equivalent yield advantage was realized with FLD under irrigated and rainfed conditions, respectively. The differences in the yield of intercropped pulses were due to the changes of the varieties over the years. The higher yield under FLD was due to additional yield obtained in intercropping and also adoption of integrated management practices. These results of higher cotton equivalent yield under intercropping in cotton are in line of work reported by Sankaranarayanan *et al.*, (2012) and Khargkharate *et al.*, (2014)

The land equivalent ratio is the indicator for assessing biological advantages of intercropping and denotes the land required for sole crop to produce the same yield under intercropping situation. In the present study, LER values more than one showed the higher efficiency of yield production of cotton with intercropping of pulses than sole crops. The mean LER under FLD was 1.26 and 1.13 under irrigated and rainfed conditions respectively indicating higher yield advantage of intercropping under irrigated conditions than rainfed conditions. Higher LER with intercropping system in cotton than sole crops were also reported by Maitra *et al.*, (2001), Velmurugan *et al.*, (2012) and Ravindrakumar *et al.* (2017).

It can be concluded from the Front Line Demonstrations that adoption of modern

varieties of cotton with improved production technologies lead higher yield, higher land use efficiency and better economic benefits which will pave way for sustainable cotton production and higher standard of living of the farming community of Southern Tamil Nadu.

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