Production Potential and Economics of Bt. Cotton based Intercropping System under Rainfed Condition

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ABSTRACT

A field experiment was conducted on medium black soil to study the production potential and economics of Bt. cotton based intercropping system under rain fed condition at Dry Farming Research Station, Junagadh Agricultural University, Targhadia, Gujarat during kharif 2015-16 to 2018-19. The experiment comprising of eight treatments with four replications laid out in randomized block design. In pooled results, the treatment intercropping of cotton + cowpea (T8) produced significantly higher MCEY (2815 kg/ha), which was statistically at par with treatment T6 (cotton + sesame), T3 (cotton + green gram), T4 (cotton + black gram) and T2 (cotton + groundnut). Among the intercrops, maximum main product yield (1074 kg/ha) was recorded with treatment T5 (cotton + gum guar) followed by cotton + soybean (896 kg/ha) and cotton + groundnut (884 kg/ha), whereas T3 (cotton + green gram) produced minimum seed yield (388 kg/ha) with cotton. Among the intercrops, gum guar recorded maximum by product yield 2609 kg/ha followed by groundnut haulm yield 2534 kg/ha and minimum by product yield 608 kg/ha recorded by green gram as intercrop with cotton.

Keywords

Bt. Cotton, Intercropping, Alternate land use system, MCEY

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Introduction

Cotton (Gossypium sp.) is one of the most important fibre and cash crop in India belongs to Malvaceae family and known as “King of Fiber” and “White gold” plays a prominent role in the rural, national and international economy. It is grown mostly for fibre used in the manufacture of cloths for mankind. In recent years, cotton apparels are being preferred to the synthetic ones due to the increasing the health consciousness among the people. Besides fibre, cotton is also valued for its oil (15 - 20%) which are used as vegetable oil and soap industries and cotton seed cake is very protein rich used as cattle feed and as manure which contain 6.4, 2.9 and 2.2 per cent N, P and K, respectively. India is a major producer of cotton. India stands first position in area and third in its production. In India it is grown over an area of 122.38 lakh hectares with production of 361.00 lakh bales and productivity of 501 kg/ha (Anon., 2018). Intensification of cotton based cropping system with intercrops was successful as a components in the system have different nutrient and moisture requirement, varied feeding zones in the soil profile, differential
growth duration for enabling the utilization of natural resources optimally (Sankaranarayanan et al., 2012). Intercropping has been recognized as potentially beneficial and economic system of crop production. Similarly intercropping is one of the ways to increase the cropping intensity and resource utilization (Harisudan et al., 2008). Usually a yield advance occurs as component crop differ in their use of resources when they are grown in combination, they are able to component each other and make better use of resources. Due to slow growing nature of cotton much of the vacant interspaces remains utilized during initial stages of the crop growth. This situation offers ample scope for raising intercrops (Nehra et al., 1990). Intercropping provides the insurance against the inclement weather situation and consequent crops (Balasubramanian, 1987) observed increase in productivity with higher market value and enhanced profitability, when pulses were intercropped with cotton. Intercropping of legumes is an important aspect for biological farming system not only for weed control, but also in reducing the leaching of nutrients, pest control and in reducing soil erosion (Prabukumar and Uthayakumar, 2006). Keeping all these views in mind an experiment was conducted to find out the effect of different intercrops on growth and yield attributes on Bt. cotton under rain fed condition.

Materials and Methods

The experiment was conducted on medium black soil of dry farming research station, of Junagadh Agricultural University, Targhadia (Gujarat) during four consecutive kharif seasons of 2015-16to 2018-19. The year wise total rainfall received during the crop growth seasons 2015 to 2018 were 604.4, 425.1, 1328.5and 613.6 mm, with 26, 27, 38and 26 rainy days, respectively. The soil of the experimental field was medium black having good drainage and high moisture retentive capacity. Some important characteristics of the soil were pH 8.30, EC 0.35dS/m, Organic carbon 0.41 %, available N, P, K and S were 230.3, 28.6, and 336kg/ha and 17.8ppm, respectively and micronutrient Fe, Mn and Zn were 10.19, 12.84and 0.66ppm, respectively. The experiment comprises eight treatments. T_1- sole cotton crop, T_2- cotton + Groundnut, T_3- Cotton + Greengram, T_4- Cotton + Blackgram, T_5- Cotton + Gum guar, T_6- Cotton + Sesame, T_7- Cotton + Soybean and T_8- Cotton+ Cowpea. The cotton variety B-II Hybrid-8, and all other crops variety likewise Groundnut variety GG-5, Green gram variety GM-4, Black gram variety Guj. BG-1, Gum Guar variety Guj.Guar-1, Sesame variety Gujarat Til-2, Soybean variety JS-335 and Cow pea variety Gujarat Cow pea-4 were sown.

The experiment was laid out in randomized block design with four replications and individual plot size of 6.0m x 4.8m (gross) and 5.0m x 2.4m (net). Cotton seeds of cv.Bt. Cot. Hybrid-8was sown at 120 cm row to row and 30 cm plant to plant distance and all other intercrops were sown at 120 cm row to row and 10 cm (Groundnut, Green gram, Black gram, Gum Guar, Sesame, Soybean, Cowpea) plant to plant distance with bullock drawn seed drill. The crops were fertilized with irrespective of RDF NPK kg/ha. All other recommended agricultural practices were followed throughout crop period. Main product yield and by product yield were recorded at the time of crop harvest. Economics of all the treatments was worked out. The Seed cotton equivalent yield and B:C ratio were calculated by using following formula.

\[
\text{Seed cotton equivalent yield} = \frac{\text{Yield of crop 'B' x Unit price of produce 'B' (Rs/q)}}{\text{Unit price of 'A' (Rs/q)}}
\]
Results and Discussion

Seed cotton equivalent yield

The data presented in table 1 revealed that Seed cotton equivalent yield was significantly affected due to different treatments in all the years of experimentation and in pooled results also. The Seed cotton equivalent yield i.e. Main Crop (seed cotton) Equivalent Yield (MCEY) was worked out considering year wise current selling rate of main produce in marketing yard.

The results revealed that during year 2015-16 treatment T₈ (Cotton + Cowpea) produced significantly the highest MCEY (3360 kg/ha), while during year 2016-17, treatment T₃ (cotton + green gram) produced significantly higher MCEY (2064 kg/ha), which remained statistically at par with intercropping of sesame, black gram, cowpea and groundnut with cotton.

During year 2017-18, treatment T₆ (cotton + sesame) produced significantly higher MCEY (2967 kg/ha), which remained statistically at par with T₈ (Cotton + Cowpea), similarly during 2018-19, treatment T₆ (cotton + sesame) produced significantly higher MCEY (3348 kg/ha), which remained statistically at par with intercropping of cowpea, groundnut and black gram with cotton.

In pooled results T₈ (cotton + cowpea) produced significantly higher MCEY (2815 kg/ha), which was statistically at par with treatments T₆ (cotton + sesame), T₃ (cotton + green gram), T₄ (cotton + black gram) and T₂ (cotton + groundnut). These results are in agreement with the findings of Ramachandrappa et al., (2016) and Manoj et al., (2013).

Main product (Pod/ Seed/ Grain) yield

The data presented in table 2 revealed that among various treatments average maximum (2015-16 to 2018-19) seed cotton yield (2124 kg/ha) was recorded in treatment T₃ (cotton + green gram) followed by sole cotton (2114 kg/ha), cotton + green gram (2060 kg/ha) and cotton+ cowpea (2047 kg/ha), whereas minimum seed cotton yield (1269 kg/ha) was recorded in treatment T₅ (cotton + gum guar).

Among the intercrop, average maximum main product yield (1074 kg/ha) was recorded with treatment T₅ (cotton + gum guar) followed by cotton + soybean (896 kg/ha) and cotton + groundnut (884 kg/ha), whereas T₃ (cotton + green gram) crop produced minimum seed yield (388 kg/ha) with cotton as base crop.

By product (Haulm/Fodder/Stalk) yield

The results presented in table 3 revealed that in average of four years, cotton as base crop produced maximum by product yield (3997 kg/ha) under treatment T₃ (cotton + green gram) followed by 3936 kg/ha as sole cotton (T₁) and 3717 with black gram (T₄) as intercrop while minimum by product yield 2909 kg/ha of cotton recorded under treatment T₅ (cotton + gum guar).

In case of different intercrops, maximum average by product yield 2609 kg/h are corded under gum guar followed by 2534 kg/ha under groundnut haulm the useful fodder of cattle and minimum average by product 608 kg/ha recorded under green gram sown as intercrop with cotton.

Results clearly indicates that by product yield potentiality of cotton in sole as well as intercrop system showing exhaustiveness of cotton as base crop in dry farming region.
### Table 1: Effect of treatments on seed cotton equivalent yield (MCEY)

| Treatment                  | 2015 - 16 | 2016 -17 | 2017 -18 | 2018 -19 | Pooled |
|----------------------------|-----------|----------|----------|----------|--------|
| T₁- Sole cotton            | 2437      | 1591     | 1998     | 2431     | 2114   |
| T₂- Cotton + groundnut (1:1)| 2233      | 1880     | 2539     | 3141     | 2446   |
| T₃- Cotton + green gram (1:1)| 2738      | 2064     | 2537     | 2693     | 2508   |
| T₄- Cotton + black gram (1:1)| 2503      | 2001     | 2409     | 2939     | 2464   |
| T₅- Cotton + gum guar (1:1)| 2082      | 1359     | 2206     | 2452     | 2025   |
| T₆- Cotton + sesame (1:1)  | 2287      | 2049     | 2967     | 3448     | 2688   |
| T₇- Cotton + soybean (1:1) | 1917      | 1664     | 2143     | 2154     | 1970   |
| T₈- Cotton + cowpea (1:1)  | 3360      | 1928     | 2656     | 3317     | 2815   |

S.Em.+: 126 122 143 176 126
C.D. at 5%: 371 358 419 517 371
C.V.%: 10.3 13.4 11.7 12.5 12

### Table 2: Effect of various treatments on seed/pod/grain/seed cotton yields (kg/ha)

| Treatment                          | 2015 - 16 | 2016 -17 | 2017 -18 | 2018 -19 | Average |
|------------------------------------|-----------|----------|----------|----------|---------|
|                                    | cotton IC | cotton IC | cotton IC | cotton IC | cotton IC |
| T₁                                 | 2437      | -        | 1591     | -        | 1998    |
| T₂                                 | 1612      | 645      | 1338     | 709      | 2053    |
| T₃                                 | 2322      | 291      | 1862     | 317      | 2041    |
| T₄                                 | 2088      | 271      | 1862     | 163      | 2066    |
| T₅                                 | 1589      | 586      | 791      | 1043     | 890     |
| T₆                                 | 1734      | 375      | 1411     | 585      | 2032    |
| T₇                                 | 1480      | 549      | 1107     | 1020     | 1688    |
| T₈                                 | 2138      | 968      | 1575     | 431      | 1951    |

Main Product yield (kg/ha)

| Treatment                          | 2015 - 16 | 2016 -17 | 2017 -18 | 2018 -19 | Average |
|------------------------------------|-----------|----------|----------|----------|---------|
|                                    | cotton IC | cotton IC | cotton IC | cotton IC | cotton IC |
| T₁                                 | 2437      | -        | 1591     | -        | 1998    |
| T₂                                 | 1612      | 645      | 1338     | 709      | 2053    |
| T₃                                 | 2322      | 291      | 1862     | 317      | 2041    |
| T₄                                 | 2088      | 271      | 1862     | 163      | 2066    |
| T₅                                 | 1589      | 586      | 791      | 1043     | 890     |
| T₆                                 | 1734      | 375      | 1411     | 585      | 2032    |
| T₇                                 | 1480      | 549      | 1107     | 1020     | 1688    |
| T₈                                 | 2138      | 968      | 1575     | 431      | 1951    |

By Product yield (kg/ha)

| Treatment                          | 2015 - 16 | 2016 -17 | 2017 -18 | 2018 -19 | Average |
|------------------------------------|-----------|----------|----------|----------|---------|
|                                    | cotton IC | cotton IC | cotton IC | cotton IC | cotton IC |
| T₁                                 | 3689      | -        | 3574     | -        | 4204    |
| T₂                                 | 2474      | 1931     | 3278     | 2870     | 4407    |
| T₃                                 | 3451      | 265      | 3944     | 1361     | 4667    |
| T₄                                 | 3016      | 380      | 3685     | 333      | 4370    |
| T₅                                 | 2431      | 2517     | 2352     | 3111     | 3278    |
| T₆                                 | 2865      | 1172     | 3185     | 1148     | 5000    |
| T₇                                 | 2452      | 1128     | 3056     | 1419     | 4296    |
| T₈                                 | 2865      | 321      | 3222     | 1500     | 4222    |
Table 4 Economics of different treatments

| Treatment | MCEY | Byproduct yield | Cost of cultivation (Rs/ha) | Gross Return (Rs./ha) | Net return (Rs/ha) | B:C ratio |
|-----------|------|-----------------|----------------------------|-----------------------|-------------------|-----------|
| T1        | 2114 | 3936            | 33065                      | 118238                | 85173             | 3.58      |
| T2        | 2446 | 3313            | 35953                      | 148857                | 112904            | 4.14      |
| T3        | 2508 | 3997            | 34747                      | 140547                | 105800            | 4.04      |
| T4        | 2464 | 3717            | 34903                      | 138033                | 103130            | 3.95      |
| T5        | 2025 | 2909            | 34104                      | 115439                | 81335             | 3.38      |
| T6        | 2688 | 3577            | 34009                      | 150247                | 116238            | 4.42      |
| T7        | 1970 | 3229            | 35210                      | 111764                | 76554             | 3.17      |
| T8        | 2815 | 3577            | 34760                      | 157324                | 122564            | 4.53      |

Economics

Economic response of sole cotton and cotton with intercrop was worked out on the basis of pooled result and presented in table 4. The data indicated that treatment T8 (cotton + cowpea in between two rows of cotton) gave maximum net return of Rs. 122564 with B:C ratio (4.53) followed by cotton + sesame (4.42), cotton + groundnut (4.14) and cotton + green gram (4.04). Pulses intercropped with cotton were also noticed by Maitraet al. (2001) to give higher returns.

In conclusion under North Saurashtra Agro Climatic Zone (AES-VI) in cotton based intercrop system under rainfed condition growing cowpea in between two rows of cotton produce higher yield and net return followed by intercropping of sesame or groundnut or green gram in between two rows of cotton as next better optional crops.

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