International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(5): 1350-1354

Received: 25-07-2019
Accepted: 27-08-2019

G Sumitra
PG Student, College of Agriculture, Dhule, Maharashtra, India

MS Mahajan
Associate Professor of Agronomy, College of Agriculture, Dhule, Maharashtra, India

PU Raundal
Associate Professor of Agronomy, College of Agriculture, Dhule, Maharashtra, India

Correspondence
G Sumitra
PG Student, College of Agriculture, Dhule, Maharashtra, India

Performance of *Deshi* cotton (*Gossypium arboreum*) in skip row planting with various intercrops under rainfed condition

G Sumitra, MS Mahajan and PU Raundal

Abstract
A field investigation on "Performance of *deshi* cotton (*Gossypium arboreum*) in skip row planting with various intercrops under rainfed condition" was undertaken during *kharif* season of 2018-19 at Agronomy Farm, College of Agriculture, Dhule. The experiment was laid out in randomized block design with seven treatments and three replications. None of the parameters of growth, yield and economics was influenced due to sole skip row planting over solid sole cropping of cotton. However, ease in picking of seed cotton in sole skip row planting of cotton was experienced. Moreover, it has created a space for growing intercrops in skipped row without affecting the plant population of base crop. At harvest, sesamum proved better intercrop in maintaining leaf area of cotton, however, both the sole cotton patterns and cotton with green gram and black gram were proved similar in maintaining leaf area of cotton.

As regards to yield attributes of cotton, intercropping of green gram, black gram, soybean and sesamum in skip row planting of cotton and both the sole cropping pattern proved similar in producing number of sympodial branches in flowering stage and they were superior to pearl millet as intercrop in skipped row. However, soybean was inferior intercrop than black gram in later stages. Dry matter accumulation in cotton was influenced during flowering stage only. Solid sole and sole skip row planting of cotton proved better than all the intercropping treatments in respect of dry matter accumulation. Average weight of seed cotton boll^{-1} and seed cotton yield plant^{-1} were higher in skip row planting of cotton + sesamum (2:1). There was a drastic reduction in yield of seed cotton plant^{-1} when cotton was grown with pearl millet. Skip row planting of cotton registered the highest seed cotton yield than skip row planting of cotton + pearl millet (2:1) however, it is on par with rest of the treatments. Similar trend was observed in respect of yield of stalk (kg ha^{-1}). Sesamum (1.33), green gram (1.27) and black gram (1.22) grown as intercrop in skip row planting of cotton recorded higher Land Equivalent Ratio. Cotton grown as either sole skip row (19.66 q ha^{-1}) or with intercrops *viz.,* green gram (21.93 q ha^{-1}), black gram (20.95 q ha^{-1}), soybean (19.82 q ha^{-1}) and sesamum (20.56 q ha^{-1}) recorded higher seed cotton equivalent yield than cotton + pearl millet (13.41 q ha^{-1}) intercropping system. Similar trend was observed in respect of gross and net monetary returns. Skip row planting of cotton + green gram (2:1) (2.87) recorded the highest B:C ratio, followed by skip row planting of cotton + black gram (2:1) (2.75) and skip row planting of cotton + sesamum (2:1) (2.74).

Keywords: Skipped row, *deshi* cotton, intercropping

Introduction
Cotton (*Gossypium* spp.) is one of the most important commercial fiber crops of the world. Cotton textile industry is the oldest agricultural industry of India. Ever since the dawn of civilization, cotton served the purpose of providing this need and even today it dominates despite of the production and marketing of many synthetic fibers. Cotton is referred as "King of Fibers" and also known as "White Gold". *Deshi* cotton species are good yielders and require least chemical inputs such as fertilizers and pesticides to obtain similar or better yield as compared to American cotton

The most appropriate planting pattern enables plant to take best advantage of growth condition, as it is ultimately connected with root development, shoot growth and fructifications. Among practices, planting pattern is one of the most important factors in determining the efficiency of utilization of natural resources to increase the production of cotton. Skip row planting increased the yield than conventional planting and also made available the space for growing intercrops without sacrificing the plant population of base crop (Khan *et al.* 2001) [3]. Skip row system not every row is planted, thus creating skips in an

established pattern. Potential economic advantages of skip-row planting include a reduction in down the row expenses such as seed, in-furrow insecticides and fungicides, starter fertilizers, and banded herbicides. Savings in field time associated with planting and harvesting with skip row production may subsequently accrue since fewer actual acres are farmed.

Material and Methods

Field experiment entitled, "Performance of *deshi* cotton (*Gossypium arborium*) in skip row planting with various intercrops under rainfed condition" was carried out during *kharif* season of 2018 at Agronomy section, College of Agriculture, Dhule. The experiment was laid out in randomized block design with seven treatments and three replications with gross and net plot size of 3.60 X 4.50 m^2 and 2.70 X 3.60 m^2, respectively. The seven treatments consisted of T_1: Sole cotton, T_2: Sole skip row planting of cotton, T_3: Skip row planting of cotton + intercropping of green gram (2:1), T_4: Skip row planting of cotton + intercropping of black gram (2:1), T_5: Skip row planting of cotton + intercropping of soybean (2:1), T_6: Skip row planting of cotton + intercropping of sesamum (2:1) and T_7: Skip row planting of cotton + intercropping of pearl millet (2:1). Five additional treatments of sole crop of green gram, black gram, soybean, sesamum and pearl millet were taken for computation of LER. *Deshi* cotton variety JLA-505, green gram variety BM 2003-02, black gram variety TAU-1, soybean variety JS-335, sesamum variety JLT-408 and pearl millet hybrid Adishakti were used in experiment. Sole crop of cotton was sown at 45 x 22.5 cm, skip row planting of cotton was sown at 45 x 15 – 90 – 45 x 15 cm and all intercrop in skip row were sown at 10 cm spacing (plant to plant). Recommended dose of fertilizer of *deshi* cotton (50:25:25 N: P_2O_5: K_2O kg ha^{-1}) was applied to all the treatments

Result and Discussion

Effect on growth attributes

Skip row planting of cotton + sesamum (2:1) recorded significantly the maximum plant height (150.20 cm) than skip row planting of cotton + pearl millet (2:1), however, it was on par with the rest of the treatments. This might be due to availability of optimum space to utilize the soil and environmental resources to the maximum extent due to less competition among crop plants. However, adverse effect of pearl millet may be due to its dominance and hybrid nature.

Sharma *et al*. (2000) [11] concluded that more plant height was from skip row spacing as compared to regular row spacing of the same plant population.

Skip row planting of cotton + sesamum (2:1) recorded significantly the highest leaf area $plant^{-1}$ than all the treatments. Minimum leaf area $plant^{-1}$ was observed at treatment of skip row planting of cotton + pearl millet (2:1). Pearl millet intercropped in cotton severely competed with it and reduced its leaf area $plant^{-1}$ to a greater extent. This may be due to the exhaustive nature of hybrid pearl millet. Singh *et al.* (2017) [7] reported that the various treatments tried under study showed that the leaf area per plant was recorded higher in sole cotton than rest of the treatments.

Number of sympodial branches was significantly influenced due to different treatments. Skip row planting of cotton + black gram (2:1) recorded significantly the highest number of sympodial branches $plant^{-1}$ than skip row planting of cotton + pearl millet (2:1) and skip row planting of cotton + soybean (2:1), however, it was on par with rest of the treatments. During this period soybean was in pod filling stage and more moisture extraction by soybean in this stage might have affected the growth of cotton. Minimum number of sympodial branches $plant^{-1}$ was observed in skip row planting of cotton + pearl millet (2:1) may be due to competitive intercrop of pearl millet. Deshmukh *et al.* (1987) [1] reported the highest number of sympodial branches per plant under skip row method of planting than other planting patterns at Cotton Research Station, Khandawa, Madhya Pradesh.

Dry matter accumulation was found to be non significant for all stages of crop growth due to different treatments. However, no pronounced effect of intercrops was observed on dry matter accumulation $plant^{-1}$. It may due to no excessive vegetative growth under rainfed condition. Similar results were also obtained by Ravindra Kumar (2017) [9].

Days to initiation squares and first boll opening of cotton was found to be non-significant, however, days to initiation of flowering was found to be significant. Days to initiation of flowering were earlier in sole skip row planning of cotton as compared to rest of the treatments. It was delayed by three days in skip row planting of cotton + black gram (2:1), skip row planting of cotton + soybean (2:1) and skip row planting of cotton + sesamum (2:1), however, it was on par with the treatment of skip row planting of cotton + pearl millet (2:1) and skip row planting of cotton + green gram (2:1). Singh and Singh (2015) [12] results showed that the Bt cotton + summer *moong* (1+1and 1+2), Bt cotton + *bajra* fodder (1+1), Bt cotton + cowpea fodder (1+2) took more number of days to flowering during both the years.

Effect on yield attributes and yield

Maximum total number of picked bolls $plant^{-1}$ was observed in the sole skip row planting of cotton (12.91) than skip row planting of cotton + pearl millet (2:1), however, it was on par with rest of the treatments. This may be due more number of sympodial branches and no competition as being sole crop. Minimum number of picked boll $plant^{-1}$ was observed in skip row planting of cotton + pearl millet (2:1). This was ascribed to an intensive competition between main crop (cotton) and intercrop (pearl millet) for the factor such as water, nutrient, light etc. required for overall growth. Singh *et al.* (2017) [13] indicated that treatments of sole cotton recorded significantly higher number of picked bolls $plant^{-1}$.

Weight of seed cotton, skip row planting of cotton + sesamum (2:1) recorded significantly higher weight of seed cotton $boll^{-1}$ than the sole cotton, sole skip row planting of cotton, skip row planting of cotton + black gram (2:1), skip row planting of cotton +soybean (2:1) and skip row planting of cotton + pearl millet (2:1), however, it was at par with the skip row planting of cotton + green gram (2:1). The lowest weight of seed cotton $boll^{-1}$ was observed in skip row planting of cotton + soybean (2:1) may be due to increased competition between main crop (cotton) and intercrop (soybean) for longer duration. Similar results in respect of weight of seed cotton $boll^{-1}$ were observed by Satish *et al.* (2012) [10].

Yield of seed cotton $plant^{-1}$ was significantly influenced by different treatments. Skip row planting of cotton + sesamum (2:1) recorded significantly higher yield of seed cotton $plant^{-1}$ than the skip row planting of cotton + pearl millet (2:1) and skip row planting of cotton + soybean (2:1), however, it was on par with rest of the treatments. This might be due to more number of picked bolls $plant^{-1}$ in the skip row planting of cotton + sesamum (2:1). Minimum yield of seed cotton $plant^{-1}$ was observed in skip row planting of cotton + pearl millet (2:1) may be due to less number of picked bolls $plant^{-1}$ and

adverse effect of pearl millet on cotton. Satish *et al*. (2012) [10] studied among intercropping systems tested, reduction in yield of cotton was relatively more by intercropping soybean.

Sole skip row planting of cotton (1966.48 kg ha^{-1}) recorded significantly the highest seed cotton yield than the skip row planting of cotton + pearl millet (2:1) (925.70 kg ha^{-1}), however, it was on par with the sole cotton, skip row planting of cotton + green gram (2:1), skip row planting of cotton + black gram (2:1), skip row planting of cotton + soybean (2:1) and skip row planting of cotton + sesamum (2:1). The maximum reduction (52.9%) in seed cotton yield ha^{-1} was observed in skip row planting of cotton + pearl millet (2:1) which was ascribed to much shading effect of pearl millet on associated cotton due to its faster growth at earlier stage resulting in tall plants and possibly due to inter-specific competitive effect of pearl millet on cotton. Kote *et al.* (2007) studied that cotton intercropped with black gram produced higher seed cotton yield than cotton intercropped with soybean.

Yield of stalk kg ha^{-1} was significantly influenced by different treatments. Skip row planting of cotton + sesamum (2:1) (2828.54 kg ha^{-1}) recorded significantly higher yield of stalk than the skip row planting of cotton + pearl millet (2:1) (1168.73 kg ha^{-1}), however, it was on par with the sole cotton, sole skip row planting of cotton, skip row planting of cotton + green gram (2:1), skip row planting of cotton + black gram (2:1), skip row planting of cotton + soybean (2:1). Second best treatment was sole skip row planting of cotton. Wankhade *et al.* (2000) [14] found that straw yield was significantly higher in cotton + soybean intercropping than cotton + black gram and cotton + green gram intercropping systems.

Economic indices

The highest land equivalent ratio was recorded in skip row planting of cotton + sesamum (2:1) (1.33) than rest of the intercropping treatments. However, it was at par with the skip row planting of cotton + green gram (2:1) and skip row planting of cotton + black gram (2:1) and superior to the skip row planting of cotton + soybean (2:1) (1.09) and skip row planting of cotton + pearl millet (2:1) (1.02). It indicated that whether association is more beneficial than sole treatment and also indicated that which crop is not suitable for association so that the association of such crops may be avoided. Similar results in respect of land equivalent ratio were observed Mwamlima *et al*. (2016) and Pujar *et al*. (2018) [6, 8].

Skip row planting of cotton + green gram (2:1) (21.93 q ha^{-1}) recorded significantly the highest seed cotton equivalent yield as compared to sole cotton and skip row planting of cotton + pearl millet (2:1), however, it was at par with the sole skip row planting of cotton (19.66 q ha^{-1}), skip row planting of cotton + black gram (2:1) (20.95 q ha^{-1}), skip row planting of cotton + soybean (2:1) (19.82 q ha^{-1}) and skip row planting of cotton + sesamum (2:1) (20.56 q ha^{-1}).This result indicated a definite yield and intercropping advantage with skip row planting of cotton + green gram (2:1). Significantly the lowest seed cotton equivalent yield was recorded under sole cotton, skip row planting of cotton + pearl millet (2:1). These results also conformity with those reported earlier by Patel *et al*. (2017) and Jayakumar and Surendran (2017) [7, 2].

The cost of cultivation of skip row planting of cotton + pearl millet (2:1) is higher (₹40491ha^{-1}) followed by skip row planting of cotton + soybean (2:1) (₹40315 ha^{-1}). The minimum cost of cultivation (₹37596 ha^{-1}) was recorded in sole cotton and sole skip row planting of cotton.

Data revealed that the highest gross monetary return of ₹112960 ha^{-1} was obtained with skip row planting of cotton + green gram (2:1) than sole cotton and skip row planting of cotton + pearl millet (2:1), however, it was on par with the skip row planting of cotton + black gram (2:1) (₹107873 ha^{-1}), skip row planting of cotton + soybean (2:1) (₹102082 ha^{-1}), skip row planting of cotton + sesamum (2:1) (₹105859 ha^{-1}) and sole skip row planting of cotton (₹101274 ha^{-1}).The lowest gross monetary return (₹69079 ha^{-1}) was noted in skip row planting of cotton + pearl millet (2:1). Similar results were in conformity with results obtained by Kulkarni (1995) [4] and Wankhade *et al*. (2000) [14].

Skip row planting of cotton + green gram (2:1) recorded significantly the highest (₹73546 ha^{-1}) net monetary return than sole cotton (₹58681 ha^{-1}) and skip row planting of cotton + pearl millet (2:1) (₹28588 ha^{-1}), however, it was on par with the skip row planting of cotton + black gram (2:1) (₹68623 ha^{-1}), skip row planting of cotton + sesamum (2:1) (₹67208 ha^{-1}), skip row planting of cotton + soybean (2:1) (₹61767 ha^{-1}) and sole skip row planting of cotton (₹63678 ha^{-1}). The minimum net monetary return (₹28588 ha^{-1}) was recorded in skip row planting of cotton + pearl millet (2:1).

The highest B:C ratio (2.87) was recorded in the skip row planting of cotton + green gram (2:1) followed by skip row planting of cotton + black gram (2:1) (2.75). Minimum B:C ratio was observed in the skip row planting of cotton + pearl millet (2:1) (1.71). Higher B:C ratio was obtained in skip row planting of cotton + green gram (2:1) and skip row planting of cotton + black gram (2:1) may be attributed to the good market prices with lower cost of cultivation. Singh and Singh (2015) [12] reported similar results.

Table 1: Growth contributing characters of cotton as influenced by different treatments

Treatments	Plant height (cm)	Leaf area plant-^{1} (d cm2)	No. of sympodial branches plant-1	Dry matter plant-1 (g)	Days to Initiation of squares	Days to initiation of flowering	Days to first boll opening
T_1:Sole cotton	142.93	284.14	19.07	90.93	45.67	61.67	100.00
T_2:Sole skip row planting of cotton	149.70	269.25	19.20	97.53	44.67	60.33	100.67
T_3:Skip row planting of cotton + green gram (2:1)	148.53	264.45	19.53	118.27	46.67	62.67	101.33
T_4:Skip row planting of cotton + black gram (2:1)	148.57	283.46	20.40	101.27	46.67	63.00	101.00
T_5:Skip row planting of cotton +soybean (2:1)	144.87	252.12	18.53	110.07	46.00	63.00	101.33
T_6: Skip row planting of cotton + sesamum (2:1)	150.20	322.07	19.07	123.57	46.67	63.00	100.67
T_7:Skip row planting of cotton + pearlmillet (2:1)	106.73	183.05	13.33	72.20	45.67	62.33	100.67
SE (m) ±	3.44	9.15	0.44	10.37	0.47	0.43	0.47
CD at 5%	10.60	28.19	1.36	NS	NS	1.33	NS
General Mean	141.65	265.51	18.45	101.98	46.00	62.29	100.81

Table 2: Yield and yield contributing characters of cotton as influenced by different treatments

Treatments	Total no. of picked bolls	Weight of seed cotton boll-1 (g)	Yield of Seed cotton plant-1 (g)	Yield of seed cotton (kg ha-1)	Yield of Stalk (kg ha-1)
T_1:Sole cotton	10.68	1.90	20.90	1869.45	2720.17
T_2:Sole skip row planting of cotton	12.91	1.84	22.67	1966.48	2811.39
T_3:Skip row planting of cotton + green gram (2:1)	12.73	1.95	22.88	1895.21	2704.06
T_4:Skip row planting of cotton + black gram (2:1)	12.30	1.83	23.73	1906.37	2637.53
T_5:Skip row planting of cotton +soybean (2:1)	10.93	1.78	17.29	1827.37	2606.66
T_6: Skip row planting of cotton + sesamum (2:1)	12.77	2.05	26.08	1862.27	2828.54
T_7:Skip row planting of cotton + pearlmillet (2:1)	7.05	1.83	9.71	925.70	1168.73
SE (m) ±	1.16	0.05	2.36	79.20	136.20
CD at 5%	3.56	0.14	7.28	244.01	419.66
General Mean	11.34	1.88	11.55	7.84	9.45

Table 3: Economic indices of intercropping system as influenced by different treatment

Treatments	LER (Cotton + Intercrop)	Seed cotton equivalent yield (q ha^{-1})	Cost of Cultivation (ha^{-1})	Gross monetary Return (ha^{-1})	Net monetary return (ha^{-1})	B:C Ratio (Cotton + Intercrop)
T_1: Sole cotton	1.00	18.69	37596	96277	58681	2.56
T_2:Sole skip row planting of cotton	1.00	19.66	37596	101274	63678	2.69
T_3:Skip row planting of cotton + green gram (2:1)	1.27	21.93	39414	112960	73546	2.87
T_4:Skip row planting of cotton + black gram (2:1)	1.22	20.95	39250	107873	68623	2.75
T_5:Skip row planting of cotton + soybean (2:1)	1.09	19.82	40315	102082	61767	2.53
T_6:Skip row planting of cotton + sesamum (2:1)	1.33	20.56	38651	105859	67208	2.74
T_7:Skip row planting of cotton + pearl millet (2:1)	1.02	13.41	40491	69079	28588	1.71
SE (m) ±	0.07	0.84	-	4334	4334	-
CD at 5%	0.20	2.59	-	13352	13352	-
General Mean	1.13	19.29	-	99343	60299	2.55

Conclusions

1. Sole skip row planting of *deshi* cotton did not show any significant influence on growth and yield of cotton as compared to sole cotton, however, ease in picking of seed cotton and created space for growing intercrop in skipped row.
2. Performance of *deshi* cotton in respect of growth and yields was better with green gram, black gram and sesamum as compared to soybean and pearl millet. Intercropping of hybrid pearl millet may be avoided with cotton.
3. The economical indices were superior with skip row planting of cotton + green gram (2:1) as compared to other treatments followed by skip row planting of cotton + black gram (2:1).

References

1. Deshmukh SC, Sisodiasand RI, Mandloi KC. Studies on planting patterns and intercropping in cotton. Journal of Cotton Research and development. 1987; 1(2):124-130.
2. Jayakumar M, Surendran U. Intercropping and balanced nutrient management for sustainable cotton production. Journal of Plant Nutrition. 2017; 40(5):632-644.
3. Khan MB, Akhtar M, A Khaliq. Effect of Planting Patterns and Different Intercropping Systems on the Productivity of Cotton (*Gossypium hirsutum* L.) Under Irrigated Conditions of Faisalabad. International Journal of Agriculture & Biology. 2001; 3(4):432-435.
4. Kulkarni RV. Studies on intercropping in cotton. M.Sc. (Agri) Thesis submitted to Dr. PDKV, Akola, 1995.
5. Kote GM, Giri AN, Kausale SP, Lomte DM. Effect of intercrops and fertilizer levels on yield and quality of different cotton (*Gossypium hirsutum* L.) genotypes under rainfed conditions. International Journal of Agricultural Science. 2007; 3(2):147-152.
6. Mwamlima LH, Kabambe VH, Mhango WG, Nyirenda GKC. Effects of intercropping on growth and yield of intercropped cotton (*Gossypium hirsutum*) and cowpea (*Vigna unguiculata* L. *Walp*) in Malawi. Agricultural Science Research Journal. 2016; 6(12):303-312.
7. Patel DG, Patel CK, Singh RN, Patel NI. Intercropping study in Bt. Cotton under rainfed condition of Kutch region of Gujarat (*Gossypium hirsutum* L.). International Journal of Science, Environment and Technology. 2017; 6(6):3484-3488.
8. Pujar AM, Angadi VV, Hosmath JA. Response of Cotton and Soybean Intercropping System to Integrated Nutrient Management. International Journal of Environment and Climate Change. 2018; 8(1):18-26. ISSN: 2231-4784.
9. Ravindra Kumar AB, Turkhede RK Nagar, Anil Nath. Effect of Different Intercrops on Growth and Yield Attributes of American Cotton under Dryland Condition. International Journal of Current Microbiology and applied Sciences. 2017; 6(4):754-761.
10. Satish PV, Raja S Mohammad, Sailaja V. Effect of intercropping on growth and seed cotton yield of Bt cotton with different planting patterns. Journal of Research ANGRAU. 2012; 40(1):21-25.
11. Sharma JK, Khamparia SK, Parsal GS, Mishtra US, Mandloi KC. Performance of cotton genotype in relation of spacing and fertility levels in East Nimar. Journal of Cotton Research and Development. 2000; 14(2):235-237.
12. Singh A, Singh T. Phenology, growth and yield of Bt cotton as influenced by different intercrops. Department of Agronomy, Punjab Agricultural University, Journal of Cotton Research and Development. 2015; 29(2):255-259.
13. Singh GP, Choudhary D, Saini, Lal Jat. Effects of legume intercrops on growth, yield and economics of hybrid American cotton under controlled condition, Department of Agriculture, Bhagwant University Ajmer, Rajasthan.

Global Journal of Bio-Science and Biotechnology. 2017; 6(1):61-82. ISSN 2278-9103.
14. Wankhade ST, Turkhede AB, Solanke VM, Malvi SD, Katkar RN. Effect of intercropping on yield of cotton. Crop Research. 2000; 19(3):409-413.