Original Research Article

RESPONSE OF VARIOUS INTERCROPS ON GROWTH AND YIELD ATTRIBUTES OF COTTON (*Gossypiumhirsutum L.*) UNDER IRRIGATED CONDITION

ABSTRACT

Intercropping in cotton is one of the ways to improve the food security and soilfertility whilst generating cash income of the rural poor. Now-a-days intercropping is common in intensiveagriculture to maximize the land use and also significant in reducing the weedsinfestation. But, introducing additional population of intercrops without reducing the base crop population is of prior importance. Therefore field experiments were conducted at farmer's field, Erode District, Tamil Nadu, India (during 2018-2019) to investigate the compatible, remunerative and best smothering intercrops on the base crop, cotton. The experiment was laid out in randomized block design with three replications. The treatment comprised of seven treatments *viz.*,Cotton alone*(Gossypiumhirsutum L.*), Cotton +Blackgram (*Vigna mungo*), Cotton + Greengram (*Vignaradiata*), Cotton+Cowpea (*Vignaunguiculata*), Cotton + Coriander (*Coriandrumsativum*), Cotton + Onion (*Allium cepa*) and Cotton + Sesame (*Sesamumindicum*). The study clearly showed that among the treatments Cotton +Cowpea showed superior response in growth attributes like plant height at harvest (153.23 cm), LAI at 70 DAS (6.18), DMP at harvest (6788.01 kg per ha)and yield attributeslike number of Monopodial branches per plant (3.22), number of Sympodial branches per plant (19.62), number of squares per plant (48.83), number of bolls per plant (32.23), boll weight (3.98 g) and seed cotton yield (2455.70t ha^{-1}) and next in order was Cotton +Blackgram. The result evidently proved that Cotton +Cowpea will be

an appropriate intercropping system for cotton and it was having considerable increase in growth and yield of cotton.

Keywords: Sole crop, intercrop, spacing. The keywords should be in alphabetical order

INTRODUCTION

Cotton *(Gossypium sp.,)* is the most important and leading fiber crop in the world. Fiber produced by the crop is the raw material for the textile industry. It is popularly called as the "White gold, King of apparel fibers and Queen of fiber" (Satish *et al.*, 2019). As on 2018, the area covered under cotton during current season was 120.64 lakh hectares, which was 124.44 lakh hectares during corresponding period of last year. Cotton production during 2018-19 was estimated at 358.70 lakh bales. In 2017-18 area covered under cotton cultivation was 1.85 lakh hectare and production are 5.50 lakh bales. In 2018-19 area under cotton cultivation was 126.58 lakh hectares and production of 330 lakh bales and 2019-20 area under cotton cultivation was 125.84 lakh hectares and production of 360 lakh bales. (Cotton Advisory Board 2020).

As a widely spaced crop cotton provides ample scope for adoption underintercropping concurrently so that they coexist for a significant part of their growing cycle and that they interact among themselves and with agro-ecosystem (Maitra and Gitari, 2020). Intercropping is one of the profoundly encouraging methodologies for improving crop yields and profitability from unit area (Nyawade*et al*., 2020).The advantages of intercropping are improving the efficiency of resource utilization. Intercropping can also provide many ecosystem services, such as reducing need for chemical inputs to control insect pests, weeds, diseases whilst diminishing greenhouse gas emission that are linked to N_2 fixation(Martin guay*et al*., 2017). Panda *et al.* (2020)this ref is not in the refliatstated that yield advantage pronounces due to better use of

growth resources such as light, water, and nutrients by the intercrop over time and space. Such advantages are also reflected in economics of cotton cultivation. Moreover, inclusion of legumes in cotton-based intercropping system can improved soil fertility. Intercropping is an appropriate practice for managing the weeds since sufficient ground area is covered by crops hence decreasing weed development. Compared to the pure stand of cotton, under intercropping system, weed population and weed biomass are reduced. Weed populace including grasses, sedges and broad-leaved weeds were diminished under paired row cotton and blackgram. Intercropping is one of the profoundly encouraging methodologies for improving crop yields and profitability from unit area (Nyawase*et al*. 2020). Ravindra Kumar *et al.* (2017) concluded that treatments of intercrops *viz*. greengram (*Vignaradiata*), blakgram (*Vigna mungo*), clusterbean (*Cyamopsistetragonoloba*) and cowpea were found equally effective in higher seed cotton yield. This might be attributed to the uniform duration of these intercrops. Cotton+cowpea (76302 Rs ha^{-1}) was significantly superior than the rest of treatments. Gross monetary returns are enhanced due to taking of intercrop with cotton. Increased productivity of cotton with additional yield of intercrops helped in increasing gross monetary returns over treatment of no intercrop with cotton.Keeping all the views in mind an experiment was conducted to find out the responseof different intercrops on growth and yield attributes of cotton.

MATERIALS AND METODS

The field experiments were conducted at farmer's field, Bommanaickenpalayam village, Gobichettipalayam Taluk, Erode District during 2018 and 2019. The cotton variety Surabhi was chosen for this study, which was raised on 20 August 2018 and 9 September 2018 and harvested on 7February 2019 and 28 February 2019. The experimental site is geographically situated at 10^{o}74' N latitude and 77^{o} 15' E longitude with an altitude of about + 213 m above mean sea level

(MSL). The mean maximum and minimum temperature are 36^{o} and 27^{o}C respectively. The relative humidity range from 5 to 63 per cent. The experimental plots had assured irrigation facility coupled with uniform topography, good drainage and soil suitable for cotton cultivation. The soil of the experimental farm is classified as udic chrom (clay) according to FAO/UNESCO (1974)this ref is not in the ref list. The soil is low in available Nitrogen, medium in available Phosphorous and high in available Potassium. The experiment was laid out in randomized block design with three replications. The treatment comprised of seven treatments Cotton alone, Cotton +Blackgram, Cotton + Greengram, Cotton+Cowpea, Cotton + Coriander (*Coriandrumsativum*), Cotton + Onion (*Allium cepa*) and Cotton + Sesame. Spacing for cotton 120 cm x60 cm. As per intercrops one row of intercrop green gram and blackgram with a plant to plant spacing of 30 cm ×10 cm were sown in between the cotton rows. One row of intercrop of sesame with a plant to plant spacing of 10 cm×25 cm were sown in between the cotton rows the seed rate adopted is 5 kg ha^{-1}. One row of intercrop of cowpea with a plant to plant spacing of 10 cm ×15 cm were sown in between the cotton rows the seed rate adopted is 5 kg ha^{-1}. One row of intercrop of coriander with a plant to plant spacing of 20 cm × 15 cm were sown in between the cotton rows the seed rate adopted is 20 kg ha^{-1}.One row of intercrop of onion with a plant to plant spacing of 20 cm × 12 cm were sown in between the cotton rows the seed rate adopted is 8 kg ha^{-1} .Five plants in each treatment in the net plot area were selected at random and tagged for biometric observations. The plant height was measured from the basal point nearer to cotyledenary node to the opened leaf of the main shoot and expressed in cm. While taking observations, five plants from sampling rows were pulled off in each treatment plot for recording dry matter production.Leaf Area Index- The length and breadth of the third leaf from the top of the plant were measured and multiplied with number of leaves and the correction factor to arrive

total leaf area plant^{-1} (Rauoson, 1980) this ref is not in the ref list at flowering stage. Then the leaf area index was calculated using the following formula:

$$LAI = \frac{K(LxW)\ (Number\ of\ leaves\ plant^{-1})}{Area\ occupied\ by\ the\ plant}$$

Where,

L = Leaf length (cm)

W = Leaf width (cm)

K = Correction factor (0.75)

The number of monopodial branches arising from auxillary buds were counted at maturity. The reproductive sympodial branches arising from extra-axillary buds were counted at maturity. Total number of fruiting points were recorded at final harvest. Total number of bolls picked at each picking till the completion of harvest ware summed up. The weight of matured bolls picked from the tagged plants were recorded and expressed in g. The seed cotton obtained from the net plot area at each picking was recorded, pooled and expressed in q ha^{-1}. The intercrops were incorporated within the interspaces after picking of pods of intercrops. The observations recorded during the experiments were analyzed statistically using the procedure outlined by Gomez and Gomez (1984). Wherever the results were found significant, the critical differences were worked out at 0.05% probability level.

RESULTS AND DISCUSSION

Growth attributes

The study revealed that the highest growth attributes (plant height, DMP, LAI) of cotton were influenced significantly in Cotton + Cowpea intercropping system (Table 1). Higherplant height at harvest (153.23 cm), LAI (6.18) at 70 DAS, DMP (6788.01 kg per ha) were recorded in

Cotton + Cowpea intercropping system than other cropping system. It was followed by cotton + blackgram which is on par with cotton + greengram. The least growth attributes of plant height was recorded under cotton + sesame. This might be due to the intercropping of cotton with cowpea might be associated with less competitive effect for space, moisture, nutrient and light (due to Annidation process) further accelerated the phototropism and thereby increased plant height of cotton. Similarly, observations of increased plant height in cotton due to different intercrops were reported by Wankhade*et al*., (2000), Deoche (2001), Kalyankar (2001), Hallikeri*et al*., (2005), Srivastava *et al*., (2010), Satish *et al* (2012), Shankarnarayan*et al*., (2012) and Ravindrakumat*et al*., (2017). Whereas lower plant height of cotton in the treatment plots of intercrop *i.e.* ,Cotton +Sunflower were due to competition of these intercrops for growth factors along with the crops of cotton. These results are in conformity with the work of Wankhade*et al*., (2000), Deoche (2001), Kalyankar (2001), Hallikeri*et al*., (2005), Srivastava *et al*., (2010), Satish *et al* (2012), Shankarnarayan*et al*., (2012) and Ravindrakumat*et al*., (2017). The higher LAI, it might be due to increased light transmission ratio could have helped towards the higher LAI. The results are in accordance with the report of PriyaDharshini*et al.* (2019)this ref is not in the ref list.Higher DMP might be due to wider row spacing of cotton and different intercrops, none of the short duration pulse crops competed with the main crop of cotton during the growth and development. Thus, cropping system through intercrop was successful as a component 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*., 2011check the year; Panda *et al*., 2021this ref is not in the ref list). Crop growth rate (CGR) was less at 30-60 DAS, attained the maximum at 60-90 DAS and declined thereafter. This might be due to higher LAI and DMP (Anbarasi and Rajendran 2017).

Yieldcharactersofcotton

The yield components of cotton *viz*., number of monopodial branches per plant(3.22), number of sympodial branches per plant (19.62),number of squares per plant (48.83), number ofbolls per plant(32.23), boll weight (3.98 g) and seed cotton yield (2455.70 t ha^{-1}) were higher under cotton +cowpeaintercroppingsystem.

Thus, intercropping with cotton was successful as a component because of cotton has different nutrient and moisture requirements, varied feeding zones in the soil profile, differential growth duration for enabling the utilization of natural resources optimally. These results are in conformity with the findings of Satish *et al.,* (2012), Khargkharate*et al.,* (2014) and Ravindrakumar*et al.,* (2017). Legume intercropping increasedthe yield of cotton by increasing the $NO_3$and NH_4concentrations and populationsof beneficial active bacteriain the cotton rhizosphere. Thesemay be the reasonsforthe increasedyieldofcottonin intercroppedtreatments. The above findings are in line with (Jayakumar *et al.,* 2008) in agreement where cottonyield increased when intercropped with legume. Legume intercropping increased the yield of cotton by increasing the NO_3 and NH_4 concentration and population of beneficial active bacteria in the cotton rhizosphere. These may be the reason for the increased yield of cotton in intercropped treatments.

CONCLUSION

It could be concluded cotton intercropped with cowpea resulted in higher growth andyield attributes over sole cotton cropping system.This was due to the wider spacing of the cotton and better resource use efficiency in intercropping system.

Table : 1 RESPONSE OF VARIOUS INTERCROPS ON GROWTH AND YIELD ATTRIBUTES OF COTTON UNDER IRRIGATED CONDITION

Treatments	Growth attributes			Yield attributes					Yield
	Plant height at harvest (cm)	DMP at harvest (kg ha^{-1})	LAI at 70 DAS	Monopodial branches per plant	Sympodial branches per plant	No. of squares per plant	No. of bolls per plant	Boll weight (g)	Seed cotton yield (tha^{-1})
T_1	123.70	6788	5.39	2.10	14.66	41.50	24.34	3.18	2214.34
T_2	142.83	6465	5.85	3.02	18.26	45.18	30.37	3.79	2336.60
T_3	141.43	6463	5.83	3.00	18.24	45.16	30.21	3.78	2334.12
T_4	**153.23**	**6788**	**6.18**	**3.22**	**19.62**	**48.83**	**32.23**	**3.98**	**2455.70**
T_5	113.27	5818	5.05	1.90	13.28	37.85	22.47	2.98	2095.36
T_6	112.75	5816	5.03	1.89	12.60	37.83	22.45	2.97	2093.12
T_7	102.32	5493	4.68	1.70	11.20	34.17	20.56	2.77	1974.10
S.Ed	3.40	105.31	0.10	0.06	0.44	1.19	0.61	0.06	38.91
CD (P=0.05)	10.37	321.21	0.31	0.18	1.35	3.64	1.85	0.18	118.68

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