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Effect of organic sources of nutrients application on productivity and economics of cotton

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ABSTRACT : Field experiments were carried out at Tamil Nadu Agricultural University, Cotton Research Station, Srivilliputtur during August to January 2017-2018 and 2018-2019 to study the effect of various organic materials on growth, yield and economics of cotton variety SVPR 4 under irrigated conditions. The experiments were conducted in randomized block design with three replications. Eleven treatments consisted of an absolute control (T_{1} - No organic and inorganic), control (T_{2} - RDN through inorganic), Recommended dose of nutrient through organic based on P equivalent basis (T_{3}), Seed treatment and soil application of bio fertilizers with foliar application of PPFM (T_{4}), *Neem* cake application at 250 kg/ha (T_{5}), Raising of sunnhemp and incorporation before flowering (T_{6}), *In situ* – incorporation of green gram (T_{7}), Combination of seed treatment and soil application of bio fertilizers, PPFM and *neem* cake (T_{8}), Combination of seed treatment and soil application of bio fertilizers, PPFM and sunnhemp incorporation (T_{9}), Combination of seed treatment and soil application of bio fertilizers, PPFM, *neem* cake and sunnhemp incorporation (T_{10}), Combination of seed treatment and soil application of bio-fertilizers, PPFM, *neem* cake and intercropping with green gram (T_{11}). The results revealed that taller plants, higher monopodia, sympodia, bolls / m^2 and boll weight were associated with the application of recommended dose of inorganic fertilizers but this was comparable with all other organic applied treatments and significantly higher than absolute control. Though the application of inorganic fertilizers recorded the highest seed cotton yield (1790 kg/ha in 2017-2018 and 1875 in 2018-2019), its effect was *on par* with that of combined practice of seed treatment, *neem* cake application, sunnhemp incorporation, soil application of bio fertilizer and foliar application of PPFM (1701 and 1748 kg/ha during 2017-2018 and 2018-2019, respectively) and also combined practice of seed treatment, sunnhemp incorporation, soil application of biofertilizer, foliar application of PPFM and intercropping of green gram during both the years of study. The economic analysis revealed that higher gross income and net income were associated with inorganic fertilizer application followed by combination of seed treatment and soil application of bio fertilizers, PPFM, *neem* cake and sunnhemp incorporation.

Key words : Cotton, economics, organic nutrients, seed cotton yield

Cotton also known as **"White Gold"** and **"King of Fibre Crops"** is an important fibre cum cash crop in India and Tamil Nadu as well. In Tamil Nadu, cotton is cultivated in an area of 1.42 lakh ha during 2017-2018 with a production 2.80 lakh bales and productivity of 599 kg/ ha which is below the world average yield of 788 kg/ ha (Anonymous, 2017). The targeted productivity with high yielding varieties and modem agriculture technologies, besides exploitation of limited natural resources, have added new dimensions to the problems for

maintaining soil fertility and sustaining the productivity. The ever increasing and escalating price of inorganic fertilizers lead to the use of organic manure as supplement. Inorganic fertilizers have contributed to environmental damage such as nitrate pollution and hence, legumes grown in intercropping are regarded as an alternative and sustainable way of introducing nitrogen into lower input agro ecosystems. Efficient production packages of cotton using different organic materials explore the avenues for realizing the potential of organic cotton yields. With these back ground, the present study was undertaken.

MATERIALS AND METHODS

Field experiments were carried out at Tamil Nadu Agricultural University, Cotton Research Station, Srivilliputtur during August to January 2017-2018 and 2018-2019 to study the effect of various organic materials on growth, yield and economics of cotton variety SVPR 4 under irrigated conditions. The experiments were conducted in randomized block design with three replications. The total eleven treatments consisted of an absolute control (T_1 - No organic and inorganic), control (T_2 - RDN through inorganic), Recommended dose of nutrient through organic based on P equivalent basis (T_3), Seed treatment and soil application of bio-fertilizers with foliar application of PPFM at 30, 60, and 90 DAS (T_4), *Neem* cake application at 250 kg/ha (T_5), Raising of sunnhemp and incorporation before flowering (T_6), Intercropping with green gram (T_7), Combination of seed treatment and soil application of bio fertilizers, PPFM and *neem* cake (T_8), Combination of seed treatment and soil application of bio fertilizers, PPFM and sunnhemp incorporation (T_9), Combination of seed treatment and soil application of bio fertilizers, PPFM, *neem* cake and sunnhemp incorporation (T_{10}), Combination of seed treatment and soil application of bio-fertilizers, PPFM, *neem* cake and intercropping with green gram (T_{11}). The cotton variety SVPR 4 and green gram variety CO 8 for intercropping were used for the study. The soil of the experimental field was sandy clay loam with a pH of 8.13. The available nutrient N, P and K status of the soil was low (162 kg/ha , high (60 kg/ha) and high (511 kg/ha), respectively. The organic farming treatments were imposed as per schedule. The bio fertilizer azophos was used at 200 g for seeds/ha and 2.0 kg / ha as soil application. The recommended dose of nutrient through organic based on P equivalent basis was applied as farm yard manure (FYM) and it was calculated as 20 t/ha. A blanket dose of 80:40:40 kg/ NPK /ha was applied for inorganic treatment. The total nutrients or doses applied in all the treatments are not same and the sources are different. The statistical method as proposed by Gomez and Gomez (2010) was used to analyse the data. The biometric observation on plant height, yield attributes and seed cotton yield were recorded and economics were also worked out.

RESULTS AND DISCUSSION

Growth attributes : The results on the effect of organics application on growth attributes of cotton are furnished in Table 1. The results revealed that all the organic applied treatments produced taller plants which was comparable with

Table 1. Effect of organic nutrients application on growth attributes of cotton

Treatments	Plant height (cm)		Monopodia/ plant	
	2017-2018	2018-2019	2017-2018	2018-2019
T_1	104.9	100.6	1.07	1.11
T_2	126.8	122.3	1.45	1.48
T_3	116.7	111.9	1.22	1.26
T_4	113.0	109.0	1.11	1.15
T_5	113.5	109.5	1.16	1.19
T_6	114.5	110.1	1.17	1.21
T_7	112.7	108.2	1.09	1.13
$T_8 – T_4 + T_5$	117.4	112.7	1.26	1.21
$T_9 - T_4 + T_6$	120.0	116.0	1.31	1.27
$T_{10} - T_4 + T_5 + T_6$	124.5	120.3	1.39	1.33
$T_{11} - T_4 + T_5 + T_7$	122.3	118.4	1.35	1.31
SEd.	7.51	7.32	0.12	0.12
CD (p=0.05)	16.97	16.54	0.27	0.29

application of recommended dose of inorganic fertilizers (T_2) and significantly higher than absolute control (no organic and inorganic - T_1. Similarly higher monoodia / plant was also observed with seed treatment and soil application of bio-fertilizers + foliar application of PPFM + raising of sunnhemp and incorporation before flowering (T_9), seed treatment and soil application of bio-fertilizers + foliar application of PPFM + *neem* cake 250 kg/ha + sunnhemp incorporation (T_6), seed treatment and soil application of bio-fertilizers + foliar application of PPFM + *neem* cake 250 kg/ha + intercropping with green gram (T_{10}), seed treatment and soil application of bio-fertilizers + foliar application of PPFM + *neem* cake 250 kg/ha (T_{10}) and recommended dose of nutrient through organic based on P equivalent basis (T_3), and this was *on par* with inorganic fertilizer application (T_2). The effect of the organic treatments T_9, T_{10} and T_{11} were comparable and significantly superior than absolute control (no organic and inorganic - T_1) in the production of taller plants and more monopodia during both the years of study. Significant superiority of *in situ* – incorporation of sunnhemp and green gram intercropping on cotton was reported by Solaimalai *et al.,* (2019).

Yield attributes : Various organic materials exhibited significant influence on all the yield attributes during both the years of study except on boll weight during 2017-2018 (Table 2). The treatments T_{2-}, T_{10} and T_{11} recorded higher monopodia, sympodia/plant and bolls / m^2 which were significantly higher than control (T_1) . The boll weight was also the highest with chemical fertilizer application which was comparable with all other organic applied treatments and significantly higher than absolute control during 2018-2019. Significantly higher bolls/plant under cotton pulses intercropping was observed by Amit and Angadi (2017) is in favour of this study. *In situ* green manuring resulted in increased bolls production as compared to sole cotton under rain-fed condition was reported by Solaimalai *et al.,* (2019). Similar results of higher yield attributes with FYM (Hulihalli and Patil, 2017) and vernicompost application (Solunke, 2011) were also in accordance with the present study.

Seed cotton yield : The results revealed that the different organic and inorganics application exerted significant effect on seed cotton yield (Table. 2). Though the application of inorganic fertilizers recorded the highest seed cotton yield (1790 kg/ha in 2017-2018 and 1875 in 2018-2019), its effect was *on par* with that of

Table 2. Effect organic nutrients application on yield attributes and yield of cotton

Treatments	Sympodia/plant		Bolls/m^2		Boll weight (g)		Seed cotton yield (kg/ha)	
	2017-2018	2018-2019	2017-2018	2018-2019	2017-2018	2018-2019	2017-2018	2018-2019
T_1	13.02	13.50	64.32	66.31	3.28	3.51	1222	1318
T_2	17.53	17.94	79.33	82.27	3.71	4.25	1790	1875
T_3	15.93	16.07	71.55	73.99	3.63	4.02	1496	1533
T_4	15.24	15.61	69.83	72.70	3.59	3.98	1336	1477
T_5	14.88	15.22	68.73	71.62	3.61	4.01	1385	1492
T_6	15.75	16.09	70.17	72.11	3.54	3.89	1416	1501
T_7	14.71	15.24	68.15	71.08	3.51	3.85	1311	1447
$T_8 – T_4 + T_5$	16.22	16.53	72.61	74.92	3.65	4.13	1427	1579
$T_9 - T_4 + T_6$	16.53	16.87	73.21	79.26	3.67	4.20	1451	1618
$T_{10} - T_4 + T_5 + T_6$	17.11	17.40	76.28	78.97	3.70	4.24	1701	1748
$T_{11} - T_4 + T_5 + T_7$	17.02	17.33	75.01	79.03	3.68	4.23	1627	1625
SEd.	0.81	0.85	4.25	4.31	0.21	0.23	76.2	78.3
CD (p=0.05)	0.86	1.91	9.73	9.65	NS	0.52	173.3	176.9

Table 3. Effect of organic nutrients application on economics of cotton

Treatments	Cost of cultivation(Rs/ ha)		Gross income (Rs/ ha)		Net income (Rs/ ha)		Benefit cost ratio	
	2017-2018	2018-2019	2017-2018	2018-2019	2017-2018	2018-2019	2017-2018	2018-2019
T_1	44200	46400	56212	60628	12012	14228	1.27	1.31
T_2	50800	52900	82340	86250	31540	33350	1.62	1.63
T_3	64200	66700	68816	70518	4616	3818	1.07	1.06
T_4	45800	48100	61456	67942	15656	19842	1.34	1.41
T_5	54700	56900	63710	68632	9010	11732	1.16	1.21
T_6	49100	52400	65136	69046	16036	16646	1.33	1.32
T_7	49200	52500	60306	66562	11106	14062	1.23	1.27
$T_8 - T_4 + T_5$	54300	56700	65642	72634	11342	15934	1.21	1.28
$T_9 - T_4 + T_6$	50100	52600	66746	74888	16646	22288	1.33	1.42
$T_{10} - T_4 + T_5 + T_6$	60600	62900	78246	80408	17646	17508	1.29	1.28
$T_{11} - T_4 + T_5 + T_7$	61300	62600	74842	74750	13542	12150	1.22	1.19

Annexure I. Total cost of cultivation (Rs/ ha) for different treatments

Treatments	Common cost	Inorganic fertilizers	FYM	ST + Soil appln of biofert + PPFM	*Neem* cake	Sunnhemp	Green gram incorpo-ration	**Total**
T_1	44200	0	0	0	0	0	0	**44200**
T_2	44200	6600	0	0	0	0	0	**50800**
T_3	44200	0	20000	0	0	0	0	**64200**
T_4	44200	0	0	1600	0	0	0	**45800**
T_5	44200	0	0	0	10500	0	0	**54700**
T_6	44200	0	0	0	0	4900	0	**49100**
T_7	44200	0	0	0	0	0	5000	**49200**
$T_8 – T_4 + T_5$	44200	0	0	1600	10500	0	0	**54300**
$T_9 - T_4 + T_6$	44200	0	0	1600	0	4900	0	**50100**
$T_{10} - T_4 + T_5 + T_6$	44200	0	0	1600	10500	4900	0	**60600**
$T_{11} - T_4 + T_5 + T_7$	44200	0	0	1600	10500	0	5000	**61300**

combined practice of seed treatment, *neem* cake application, sunnhemp incorporation, soil application of bio fertilizer and foliar application of PPFM (1701 and 1748 kg/ha during 2017-2018 and 2018-2019 respectively) and also combined practice of seed treatment, sunnhemp incorporation, soil application of bio fertilizer, foliar application of PPFM and intercropping of green gram during both the years of study. These three treatments were significantly superior than all the other treatments except T_3 during both the years of experimentation. Higher yield with *in situ* green manuring might be due to slow and steady nutrient release because of synergistic effect of organic nitrogen. Yield advantage of green gram intercropping and bio fertilizer application in cotton was documented by Marimuthu and Subbaian (2013). Similar favourable effect due to the application of FYM (Manchala, 2017 *et al.,* and Amit and Angadi, 2017) and vermicompost application (Hemlata Chitte, *et al.,* 2016) are in support of this present investigation.

Economics : The economic analysis clearly showed the superiority of inorganic fertilizers application than all the organic applied treatments (Table.3). During both the years of study, higher gross income and net income were associated with inorganic fertilizer application followed by combination of seed treatment and soil application of bio fertilizers, PPFM, *neem* cake and sunnhemp incorporation. However higher benefit cost ratio was in the order of T_2 ,T_4 , T_6 , T_9 and T_{10} .

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