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Yield and yield components of winter irrigated cotton (*Gossypium hersutum* L.) influenced by different nutrient levels

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Abstract
Field experiment was conducted to study the influence of plant nutrient levels on the seed cotton yield and yield components in cotton during winter 2018–2019 and 2019-2020 at Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India. The experiment was laid out in a Random Block Design (RBD) design with two different planting dates and six fertilizer treatments (150% RDF (N1), 125% RDF (N2), 100% RDF (N3),75% RDF (N4), 50% RDF (N5) and No fertilizer treatments (N6). The treatments were allotted randomly at each replication to reduce the experimental error. Observations on yield attributes and seed cotton yield were recorded. Yield components including number of sympodial branches/plant (10.77), number of flowers/plant (11), number of bolls/plant (12), single boll weight (10.17 g) and seed cotton yield (2247 kg/ha) were higher in the 150%RDF compared with other nutrient treatments. In the present study, 150%RDF gave high seed cotton yield and yield components of the cotton crop.

Keywords: cotton, RDF, seed cotton yield and yield component

Introduction
Cotton plays a key role in socio-economic and political affairs of the world. Its production, processing and trade generate revenue and sustain livelihoods in many countries. It is the world's leading source of natural textile fibre and fifth largest oilseeds crop which covers 40% of the global textile need and 3.3% of the edible oil, respectively. At global level India ranks first in cotton cultivation as well as production, it has been cultivated in 105 lakh hectares and the production is 351 lakh bales with average productivity of 568 kg/ha. Among the nine major cotton growing states of India, Maharashtra stands first in the cultivated area (38.06 lakh ha) followed by Gujarat (24 lakh ha) and Telangana (12.5 lakh ha). Tamil Nadu had a cotton cultivated area of 1.5 lakh hectares with a production of 3.8 lakh bales and productivity of 680 kg/ha. Gujarat produce 91.8 lakh bales, the highest, followed by Maharashtra (83.25 lakh bales) and Telangana (47.40 lakh bales). Karnataka had high productivity of cotton (769 kg/ha) followed by Andhra Pradesh (719 kg/ha). Not only locally but also globally cotton is facing challenges that not only affect sustainable production but also competition with other artificial fibres in the textile industry. At present cotton production face problems of rising input costs with static or declining returns. The cotton producers are persistently searching for ways to compensate, the increase in production cost through more production of bolls per unit area. The adjustment of plant density has been an important agronomic practice for enhancing yield and profitability of cotton (Gossypium hirsutum L.) world-wide. Maximum yield can be achieved by maintaining an optimal plant population, with good crop growth and better plant morphological characteristics. Establishment of an acceptable population of cotton seedlings is paramount for high yields [6]. Plant population factor in cotton production is directly related to seed cotton yield, thus spacing plays a significant role for cotton production and productivity. The maximum yield potential of any new developed genotype in hirsutum cotton can be attained by manipulating and suitable spacing choice. Therefore the present research was designed to study the performance of newly developed cotton variety with different plant nutrient management treatments.

Materials and Method
Field experiment was conducted to study the influence of nutrient in cotton on the growth and yield during winter season of 2018-2019 and 2019-2020 (August to January). The experiment was carried out in Field No. D4 at Cotton Breeding Station, Centre for Plant Breeding and

Genetics, Tamil Nadu Agricultural University, Coimbatore, located in the Western Agro-climatic zone of Tamil Nadu which is geographically situated at 11° N latitude, 76° E longitude and at an altitude of 426.7 metres above mean sea level (MSL). The climatic conditions at that season were favourable for satisfactory growth of the crop. The experiment was laid out in a Random Block Design (RBD) design with three replications. The experiment comprised of eighteen treatment combinations, containing one variety and six nutrient management treatments. The treatments were allotted randomly at each replication to reduce the experimental error. With different treatment details like 150%RDF, 125%RDF, 100%RDF, 75%RDF,50%RDF and no applications of fertilizer with a duration of 135 days. CO 17 variety is a compact and erect type with Medium long staple (27.3 mm), High (37.4%) and synchronized boll maturity comes to harvest early. The crop was sown and raised using the recommended package of practices as per TNAU crop production guide (Ridges and furrow method, sowing date - August 15 to September 15). Observations were recorded for yield parameters like sympodial branches/plant, number of flowers/plant, number of bolls/plant, number of bolls/m2, single boll weight (g), number of seeds/boll, seed cotton yield (kg/ha) and lint yield (kg/ha). The experimental data on different characters of observation was statistically analyzed as described by. Agres software was used for the analysis. Wherever the results were significant, critical differences were worked out at 5% level of probability. The treatment differences that were non significant are denoted as NS.

Results

Yield Components

The number of sympodia/plant significantly higher sympodia/plant (10.77) was produced in 150%RDF treatment. While no application of nutrient produced lesser sympodia/plant (6.88). Sympodial length was measured at harvest stage and presented in Table 4.1.Nutrient level had a significant influence on sympodial length N6 recorded lesser sympodial length (7.9 cm) and Higher sympodial length (12.31 cm) was noted from the 150% RDF nutrient level. Application of different fertilizer levels significantly influenced the number of squares/plant. The nutrient level of 150% RDF produced significantly higher number of squares/plant (16.17squares/plant) which was comparable with fertilizer level of 125% RDF (16.07 squares/plant). Lesser number of squares/plant (11.5squares/plant) was observed with the application of 0% RDF and it was on par with 50%RDF. Interaction effect of nitrogen levels and date of sowing, showed significant in both the years in every components. The data on number of flowers/plant was taken at peak flowering stage. Number of flowers/plant was significantly influenced by the treatment 125% RDF produced significantly higher number of flowers/plant (10.4) than other treatments. Lesser flowers/plant (8.1) was produced No application of nutrient treatment.

Table 1: Effect of nutrient management practices and date of sowing on yield components

Winter Irrigated cotton										
	2018-19					2019-20				
Treatments	Sympodia/ plant	Number of sympodia length	Number of squares/ plant	Number of flowers/ plan	Total number of bolls/ plant	Sympodia/ plant	Number of sympodial length	Number of squares/ plant	Number of flowers/ plan	Total number of bolls/ plant
N1	10.77	11.62	16.17	9.98	11.89	10.88	12.31	16.26	10.13	11.05
N2	10.56	11.49	16.07	10.14	11.26	10.78	12.23	16.33	10.4	11.85
N3	10.35	11.04	15.05	9.92	10.42	10.27	11.63	15.25	10.11	10.42
N4	9.89	10.4	14.91	8.74	10.51	9.29	11.2	14.91	9.83	10.86
N5	9.58	10.01	12.29	8.14	9.3	9.15	11.08	14.75	9.53	10
N6	6.88	7.87	11.5	8.1	7.3	6	7.04	9.23	6.89	7.48
MEAN	9.67	10.41	14.33	9.17	10.11	9.4	10.91	14.46	9.48	10.28
SEd	0.262	0.505	2.06	0.983	0.764	0.4279	0.3284	0.8347	0.6947	0.9839
CD(0.05)	0.547	1.056	NS	NS	1.597	0.8939	0.6861	1.743	1.4512	2.0554

*Yield parameters recorded at 60, 90, 120 DAS and at harvest If Observed Difference (OD) > Critical Difference (CD), treatments are significantly differed. If OD < CD, difference between two treatments are varied. NS – Non Significant

Seed cotton yield

Application of different fertilizer doses influenced the seed cotton yield significantly. Higher seed cotton yield (2247kg /ha) with significant level was obtained due to the fertilizer level of 150% RDF (N1), and it was comparable with 125% RDF (N2) recorded 2217 kg/ha and 100% RDF(N3) nutrient application (2124 kg/ha). Lower yield (885 kg/ha) was noted from the usage of No fertilizer (S3). In 2019, the yield is more compare to the previous season (2018). Interaction effect of nitrogen levels and date of sowing on seed cotton yield showed significant in both the years. Application of different fertilizer levels significantly influenced the stalk yield. The fertilizer level of 125% RDF (N2) recorded higher stalk yield (4376 kg/ha) compared to other nutrient levels. Lower stalk yield (1063 kg/ha) was obtained from the application of No fertilizer application (N6). Different fertilizer levels had influenced the harvest index significantly. No Application of nutrient (N6) recorded significantly higher HI (0.37) than others and it was on par with 75% RDF (N4) and 150% RDF (N1) recorded the HI value of 0.36 and 0.36, respectively. Application of 50% RDF (N5) recorded lower HI (0.26).

Table 2: Effect of nutrient management practices on yield of cotton Seed (kg/ha)), Stalk yield and Harvest index

	Winter Irrigated cotton					
	2018-19			2019-20		
Treatments	**Cotton seed(kg/ha)**	**Stalk yield**	**Harvest Index**	**Cotton seed(kg/ha)**	**Stalk yield**	**Harvest Index**
N1	2247	4151	0.36	2517	3866	0.38
N2	2217	4376	0.35	2459	4102	0.40
N3	2124	3763	0.33	2226	3853	0.34
N4	2173	3830	0.36	2272	3415	0.36
N5	1821	2713	0.26	2126	2918	0.30
N6	885	1063	0.37	1414	1362	0.18
MEAN	1911.67	3316.39	0.34	2169	3253	0.33
SEd	148.60	409.08	0.15	124.34	238.02	0.03
CD(0.05)	310.44	854.62	NS	259.76	497.25	0.06

Yield parameters recorded at 60, 90, 120 DAS and at harvest If Observed Difference (OD) > Critical Difference (CD), treatments are significantly differed. If OD < CD, difference between two treatments are varied. NS – Non Significant

Discussions

Yield and yield parameters

Different levels of nutrient showed a non-significance difference on number of sympodia (Fig 1). The reason behind this was due to number of branches is a plant genetic character and governed by the gene and hence, did not affect by the external factors.

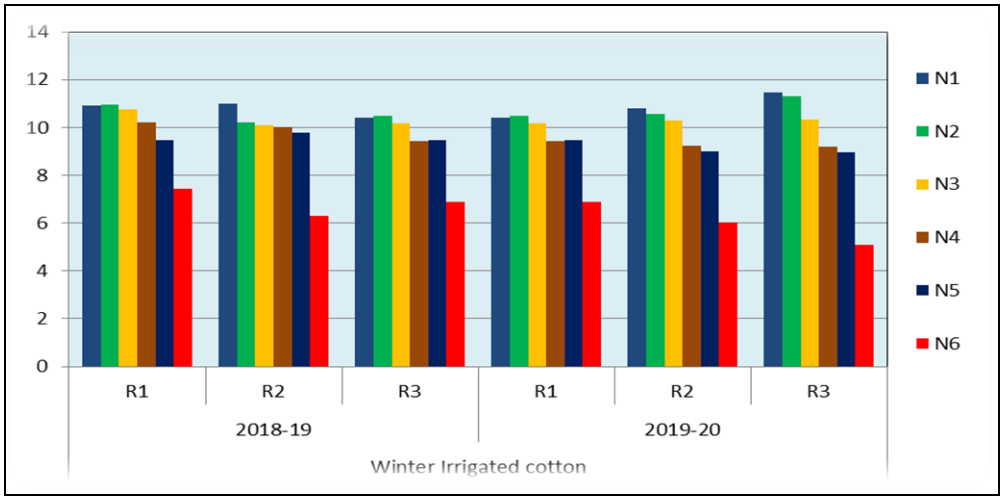

Fig 1: Effect of nutrient management practices on number of sympodia/plant of cotton

The results are agreed with the findings reported by Sharma and Singh (1993) [14], Tarhalkar and Venugopalan (1995) [17] and Saxena (2008) [11]. There was no variation among the nutrient levels on sympodial length and it was similar to the result of Sankat *et al*. (2017) [13] who found there was no difference due to fertilizer levels.

Different levels of nutrient showed a variation in number of squares/plant and flowers/plant. Application of 150% RDF produced more squares and flowers/plant. This might be due to uptake of nitrogen, phosphorus and potassium, helped in producing higher plant vigour in terms of total number of branches and productive branches, which ultimately resulted in increased number of squares and flowers/plant.

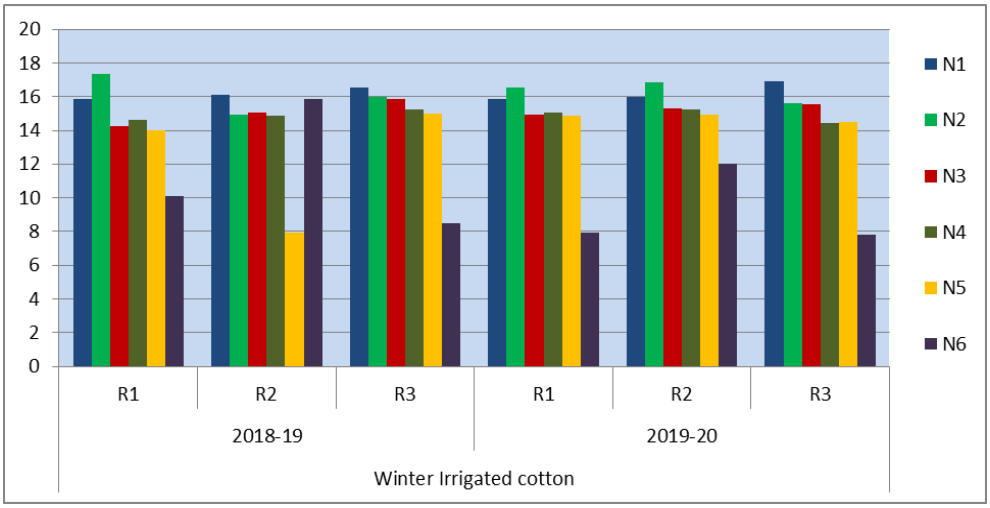

Fig 2: Effect of nutrient management practices on number of squares

Policepatil (2007) [8] reported the similar findings. Application of 150% RDF produced more bolls/plant compared to other fertilizer doses (Fig 2). This might be due to increase in fertilizer doses increased the number of bolls/plant up to a certain level. Such finding was in close confirmation with the findings of Ravikiran *et al*. (2012) [9], Pandagale *et al*. (2015) [6] and Basha *et al*. (2017a).

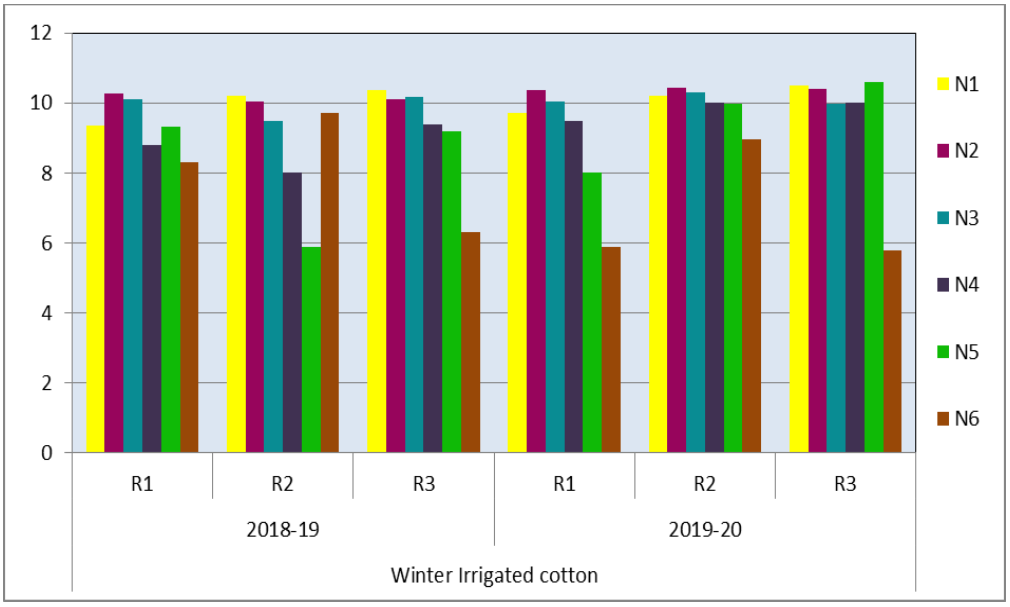

Fig 3: Effect of nutrient management practices on number of flower

This differential response of yield contributing character was due to the genetic potential and resource availability to the crop. Udikeri and Shashidhara (2017) also reported similar findings. Saxena (2008) [11] suggested that supplying balanced nutrients throughout the crop season caused higher bolls/plant. Application of increased levels of fertilizer increases the boll weight but it did not influence the boll weight significantly. Such finding is in close confirmation to the findings of Sankat *et al*. (2017) [13]. Application of different fertilizer doses showed difference in seed cotton yield and application of 150% RDF (N1) recorded higher yield. Among different yield components, number of open bolls/plant and boll weight (g/boll) exerted a greater influence on the seed cotton yield.

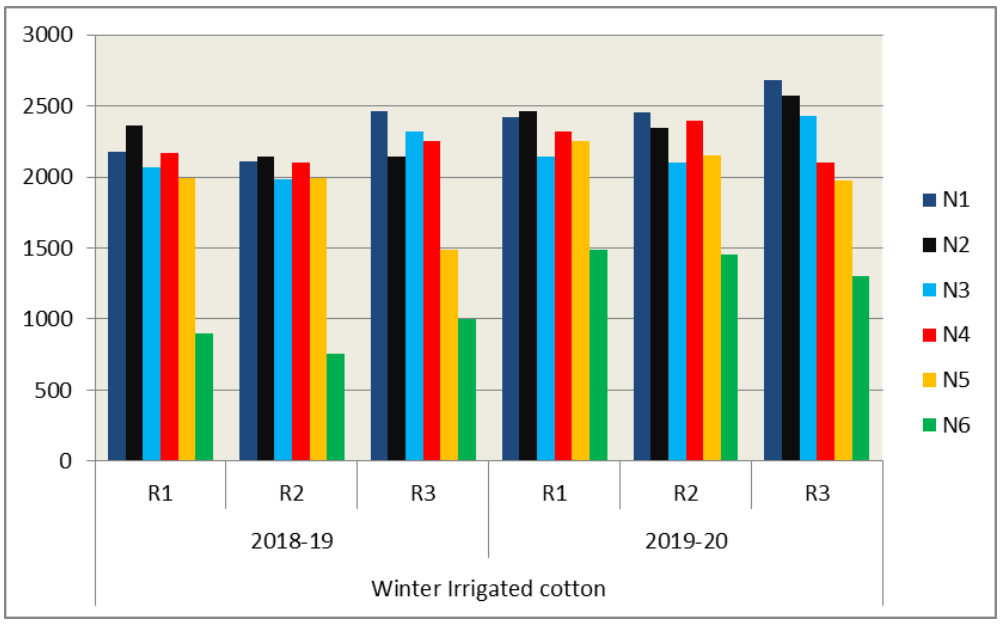

Fig 4: Effect of nutrient management practices on yield of cotton Seed (kg/ha))

Venugopalan and Blaise (2001) [18], Shivalingaiah (2007) [15], Ravikiran *et al*. (2012) [9] and Singh *et al*. (2012) reported similar findings. Nitrogen and phosphorus plays an important role in flowering, square formation and seed setting. On the other hand, phosphorus is the main element of various nucleic acids and enzymes which take part in many metabolic activities of plant and also responsible for metabolism of nitrogen compound which is accountable for better development of plant as well as fruiting bodies (Saxena, 2008) [11].

Application of increased levels of fertilizer leads to maximum plant height, more sympodial branches, leaf area etc., which resulted in higher stalk yield. Similar results were found by (Channagoudra, 2012) [3]

Excess nutrients encourage the vegetative growth and thereby reduction in seed cotton yield which in turn lower the HI was obtained from 150% RDF. Similar findings were reported by Ruba (2011) [10]. The quality parameter was highly controlled by genetic makeup of the plant stated by Aruna and Reddy (2010) [1], Narayana *et al*. (2007) [5], Srinivasulu *et al*. (2007) [16] and Gacche and Gokhale (2018) [4]. None of the quality parameters were significantly influenced by nutrient levels as reported by Hulihalli and Patil (2008), Biradar *et al*. (2010), Aladakatti *et al*. (2011) and Sankaranarayanan *et al*. (2018) [12].

Conclusions

Yield and yield parameters

150% RDF recorded highest number of sympodial plant (10.77), sympodial length(11.62 cm) of the cotton crop, number of square, flowers and bolls per plant recorded in highly recommend dose of fertilizer level (150% RDF).Higher seed cotton yield (2247kg /ha) with significant level was obtained due to the fertilizer level of 150% RDF (N1) and Lower yield (885 kg/ha) was noted from the usage of No fertilizer (N6).The fertilizer level of 125% RDF (N2) recorded higher stalk yield (4376 kg/ha) compared to other nutrient levels and Lower stalk yield (1063 kg/ha) was obtained from the application of No fertilizer application (N6). No Application of nutrient (N6) recorded significantly higher HI (0.37) than others and it was on par with 75% RDF (N4) and 150% RDF (N1) recorded the HI value of 0.36 and 0.36, respectively. Application of 50% RDF (N5) recorded lower HI (0.26).

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