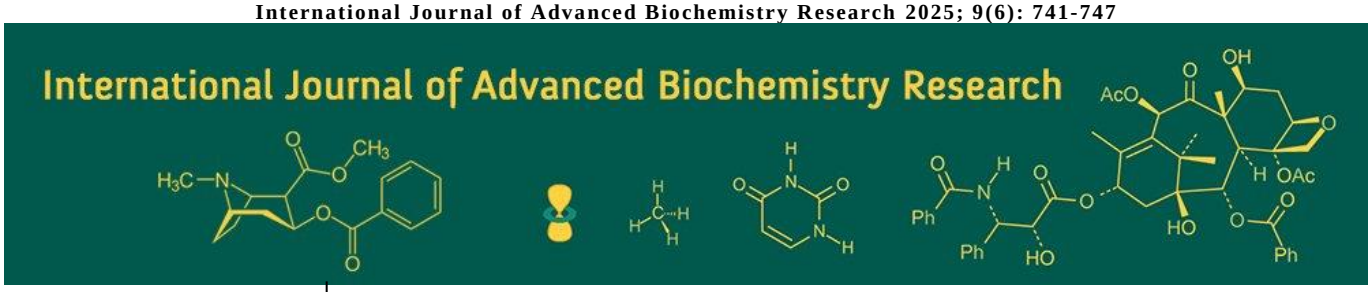

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Effect of vermicompost-derived nitrogen on fibre quality traits, ginning percentage, and lint index in organic cotton cultivars

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Abstract
A field experiment was conducted during the *Kharif* season of 2020-21 at the Centre for Organic Agriculture Research and Training (COART), Department of agronomy, Dr. PDKV, Akola, to evaluate the impact of nitrogen application through vermicompost on the fibre quality attributes of cotton under organic cultivation. The study involved two nitrogen levels (40 and 60 kg N ha^{-1}) applied via vermicompost across different *Gossypium hirsutum* and *G. arboreum* cultivars in a factorial randomized block design. Significant variations were observed in staple length and fibre strength across treatments. The maximum staple length (28.74 mm) and highest fibre strength (32.17 g tex^{-1}) were recorded in *G. hirsutum* cultivars receiving 60 kg N ha^{-1}, indicating superior response to organic nitrogen. Micronaire values (4.14-4.24 µg $inch^{-1}$), uniformity ratio (82.33-84.35%), elongation percentage (5.78-6.12%), ginning percentage (34.0-38.1%), and lint index (2.41-3.44 g) showed minimal to no statistically significant variation among treatments. The results underscore the genotypic influence of *G. hirsutum* over *G. arboreum* in fibre quality traits and highlight the potential of vermicompost as an effective organic nitrogen source for enhancing cotton fibre parameters, particularly staple length and fibre strength, under sustainable production systems.

Keywords: Cotton fibre quality, fibre strength, organic cotton cultivation, staple length, vermicompost

1. Introduction
Cotton (*Gossypium* spp.) remains one of the most significant fibre crops globally, serving as the cornerstone of the textile industry and supporting rural livelihoods, particularly in developing countries like India. Among the four cultivated species, *G. hirsutum* (upland or American cotton) and *G. arboreum* (Desi cotton) are predominantly grown, with *G. hirsutum* accounting for more than 90% of total cotton production due to its superior yield and fibre characteristics (Venugopalan *et al.*, 2011) [43].

Organic cotton production is gaining momentum as a sustainable and eco-friendly alternative, especially under rainfed conditions in countries like India, where a significant area is cultivated on marginal lands (Reddy *et al.*, 2024; Kumar *et al.*, 2021) [35, 20, 21]. However, nutrient management in organic systems remains a challenge, especially under rainfed conditions on Vertisols, Nitrogen is a critical macronutrient that influences plant growth, boll development, and fibre synthesis (Reddy *et al.*, 2022) [33]. Adequate nitrogen availability during the flowering and boll formation stages is essential for the biosynthesis of proteins and enzymes associated with fibre elongation and thickening (Pettigrew, 2004) [29]. However, managing nitrogen in organic farming is particularly challenging due to the reliance on slower-release organic inputs. Among the available organic sources, vermicompost produced through the biological degradation of organic matter by earthworms has emerged as a promising alternative due to its rich nutrient profile, high microbial activity, and ability to enhance soil fertility (Reddy *et al.*, 2024; Edwards *et al.*, 2004) [35, 8]. Vermicompost not only supplies nitrogen in plant-available forms such as ammonium and nitrate but also improves soil structure and microbial dynamics, contributing to improved nutrient uptake and fibre development (Bachman & Metzger, 2008) [3].

Several studies have reported positive effects of vermicompost on yield and physiological traits in cotton, yet limited data are available on its influence on fibre quality parameters

under organic production systems (Singh *et al.*, 2022; Yadav *et al.*, 2020; Arancon *et al.*, 2006) [38, 46, 2]. Moreover, differential responses among cotton species such as *G. hirsutum* and *G. arboreum* to organic nutrient sources, particularly nitrogen supplied through vermicompost, have not been comprehensively explored.

Cotton fibre development is a complex physiological process influenced by genetic, environmental, and nutritional factors (Reddy *et al.*, 2025) [32]. Fibre quality parameters such as staple length, strength, micronaire, and ginning efficiency are critical determinants of spinning performance and market value (Zhang *et al.*, 2012) [48]. Adequate nitrogen availability during critical growth stages is known to promote cell expansion and fibre elongation, thereby improving staple length, strength, and overall quality. The gradual nutrient release from vermicompost offers a steady supply of nitrogen, which may favourably influence fibre maturation and ginning efficiency without compromising fibre fineness or uniformity. However, limited research exists on its impact on fibre quality parameters in cotton, particularly under organic and rainfed conditions.

Therefore, the present study was undertaken to evaluate the effect of nitrogen applied through vermicompost on fibre quality traits, ginning percentage, and lint index in organic cotton cultivars of *G. hirsutum* and *G. arboreum*. Therefore these findings aim to provide insights into species-specific nutrient responses and to develop organic nutrient management strategies that enhance both yield and fibre quality under sustainable production systems. and reinforce the potential of vermicompost as a sustainable input for fibre quality enhancement.

2. Materials and Methods

2.1 Site, climate and soil characteristics

The field experiment was conducted at the Central Research Farm, College of Agriculture, Dr. Panjab Rao Deshmukh Krishi Vidyapeeth, Akola, situated in a subtropical climatic region at 22°42′ N latitude and 77°02′ E longitude, with an elevation of 304.42 meters above mean sea level. The experimental location exhibited a uniform topography and was underlain by Vertisols, classified as Typic Haplusterts, with montmorillonitic, hyperthermic characteristics. The soil was clay loam in texture and rich in smectitic minerals, known for their pronounced swelling and shrinking properties. The area receives an average annual rainfall of approximately 1084 mm, predominantly during the southwest monsoon season (July to September). During the crop growth period, the maximum daytime temperature reached 40.4 °C, while the minimum nighttime temperature dropped to 15.8 °C. Prior to the experiment initiation in May 2007, surface soil (0-15 cm) was sampled and characterized as sandy loam with a pH of 7.6 (1:2.5 soil-water; Jackson, 1973) [15], 0.49% organic carbon (Walkley and Black, 1934) [44], 195 kg ha^{-1} available nitrogen (Subbiah and Asija, 1956) [40], 16.74 mg kg^{-1} available phosphorus (Olsen *et al.*, 1954) [25], and 328 kg ha^{-1} exchangeable potassium (Hanway and Heidel, 1952) [11].

2.2 Experiment details

A field experiment was initiated during the *Kharif* season of 2020 to investigate the influence of vermicompost-derived nitrogen on the fibre quality traits, ginning percentage, and lint index of organic cotton. The study involved two nitrogen application levels through vermicompost 40 kg N ha^{-1} and 60 kg N ha^{-1} applied across different cotton cultivars. The experiment was laid out in a factorial randomized block design (FRBD) consisting of eight treatment combinations, each replicated three times. Each plot measured 5.4 m × 6.0 m^2. A seed rate of 10-12 kg ha^{-1} was used, with sowing done by dibbling at a spacing of 90 × 30 cm.

Table 1: Treatment details

Tr.	Treatment details
T_1	AV1N1-Arboreum cultivar + 40 kg N ha^{-1}
T_2	AV1N2-Arboreum cultivar + 60 kg N ha^{-1}
T_3	HV1N1-Hirsutum cultivar + 40 kg N ha^{-1}
T_4	HV1N2-Hirsutum cultivar + 60 kg N ha^{-1}
T_5	AV2N1-Arboreum cultivar + 40 kg N ha^{-1}
T_6	AV2N2-Arboreum cultivar + 60 kg N ha^{-1}
T_7	HV2N1-Hirsutum cultivar + 40 kg N ha^{-1}
T_8	HV2N2-Hirsutum cultivar + 60 kg N ha^{-1}

- HV1-Chetna J1
- HV2-GHV 8023
- AV1-AVC 14
- AV2-GAV 8011

2.3 Determination of quality parameters

Fibre qualities were tested by using High Volume Instrument (HVI) as suggested by (Sundaram, 1979) [41].

2.3.1 Staple length (mm)

The mean staple length was determined by HVI where the weight ratio method was adopted and expressed in mm.

2.3.2 Micronaire value (10^{-6} g inch^{-1})

It is an important quality characteristic, which plays a prominent part in determining the spinning value of cotton especially the long staple varieties. It is the measure of fibre weight in mg per g unit length of fibre and expressed in 10^{-6} g cm^{-1} or 10^{-6} g inch^{-1} or millitex.

It is determined by micronaire instrument in which 50g of the sample is taken and compressed in a cylinder of specified dimension. Air at specific pressure is passed through the material. The amount of airflow is measured on a scale calibrated directly to read the weight per unit length of the fibre. Finer cottons have lower micronaire value.

2.3.3 Fibre strength (g tex^{-1})

It is the ratio of the breaking strength of a bundle of fibres to its weight. It was expressed in tenacity at 1/8" gauge on stelometer. In metric system, this value is expressed as tenacity and it is expressed in terms of g tex^{-1}. Where, tex denotes weight in g of 1 kilometer of the fibre.

2.3.4 Uniformity ratio

It is the ratio of 50 percent span length to the 2.5 percent span length and expressed in percentage.

$$\text{Uniformity ratio (\%)} = \frac{\text{50 percent span length}}{\text{2.5 percent Span length}}$$

2.3.5 Lint index

The lint index which is a ratio between lint and seed and expressed as weight of lint obtained per seed of cotton gives absolute production of lint per seed on an area basis as

ginning outturn gives only approximate production of lint. Lint index is calculated for each and every plot.

2.3.6 Gin out turn percentage
Out turn of lint to seed cotton expressed as percentage by weight normally varies between 24-38%.

GOT% = Weight of lint/Weight of seed cotton x 100

3. Statistical analysis
The experimental layout was based on a factorial randomized block design (FRBD). Data collected from the field were subjected to statistical evaluation using analysis of variance (ANOVA) following the methodology described by Gomez and Gomez (1984). The statistical computations were performed using SPSS software (Version 26.0). To determine the variability among treatment means, standard errors [SE(m)±] were computed. The significance of treatment effects was assessed through the F-test, and where statistically significant differences were detected ($p < 0.05$), treatment means were further differentiated using the Critical Difference (CD) test at the 5% level of probability. The resulting summary tables include both the standard error and the CD values, which served as the basis for interpreting the impact of treatments on various observed parameters.

3. Results and Discussion
3.1 Fibre quality parameters
3.1.1 Staple length (mm)
Staple length, a vital fibre quality parameter, refers to the average length of a representative portion of fibres within a cotton sample. This attribute plays a significant role in determining the efficiency of spinning and the quality of the resulting yarn. Longer fibres enable greater twist potential during spinning, resulting in finer, stronger yarns, whereas shorter fibres necessitate additional twisting, often producing weaker and inferior yarn. In the present study, staple length was significantly influenced by different organic treatments, with recorded values ranging from 25.55 mm to 28.74 mm. Based on standard classification, these values fall within the medium staple category (25.0-29.0 mm), whereas lengths below 24.5 mm are categorized as short, and those above 29.5 mm are classified as long or very long.

The highest staple length (28.74 mm) was recorded in treatment T_4, which involved the application of 60 kg N ha^{-1} through vermicompost to the *Gossypium hirsutum* cultivar Chetna J1. Conversely, the lowest length (25.55 mm) was observed in treatment T_1, where 40 kg N ha^{-1} was applied to the *G. arboreum* cultivar AVC 14. The superior performance of T_4 can be attributed to enhanced vegetative growth and sustained nutrient availability from vermicompost, which likely facilitated better fibre elongation and development. These findings are in alignment with earlier studies by Sarkar and Majumdar (2002) [36], who reported improved fibre span length and lint yield following the application of farmyard manure at 10 t ha^{-1}. Kumar *et al.* (2017) [19] observed the longest staple length (26.95 mm) under the combined application of in-situ green manuring and FYM at 10 t ha^{-1}, further supporting the beneficial role of organic inputs in enhancing cotton fibre attributes.

Table 2: Effect of varying levels of nitrogen through vermicompost on quality parameters of cotton

Treatments	Staple length (mm)	Micronaire (micro g inch^{-1})	Fiber strength (g tex^{-1})	Uniformity ratio (%)	Elongation (%)
T_1	25.55	4.24	31.20	82.33	5.78
T_2	26.98	4.24	29.97	83.24	5.86
T_3	28.34	4.15	31.47	83.66	6.04
T_4	28.74	4.14	31.87	83.82	6.12
T_5	26.19	4.21	30.33	83.06	5.82
T_6	26.80	4.20	31.20	83.29	5.90
T_7	26.47	4.18	32.17	84.20	5.95
T_8	27.75	4.16	31.27	84.35	5.94
SE (m)±	0.168	0.03	0.31	0.24	0.12
CD at 5%	0.304	NS	0.49	NS	NS

3.1.2 Fibre/Bundle strength (g tex^{-1})
Fiber strength plays a crucial role in determining the spinning performance and tensile quality of cotton yarn, which directly influences its durability and end-use properties (Hussain *et al.*, 2022) [13]. In the current investigation, the fibre strength across treatments varied from 29.97 to 32.17 g tex^{-1} (Table 2). According to standardized classification, all values fall under the "very low" category (very low: <34.5 g tex^{-1}; low: 34.5-37.4 g tex^{-1}; average: 37.5-43.0 g tex^{-1}; good: 43.1-47.7 g tex^{-1}; very high: >47.5 g tex^{-1}). Despite this, measurable and statistically significant variation was observed among treatments.

The highest fibre strength (32.17 g tex^{-1}) was recorded in treatment T_7, where 40 kg N ha^{-1} was applied via vermicompost to *Gossypium hirsutum* cultivar GHV 8023. This treatment showed a clear improvement over T_2 (29.97 g tex^{-1}), which involved 60 kg N ha^{-1} applied to *G. arboreum* cultivar AVC 14. The superior performance of T_7 could be attributed to the multifaceted benefits of vermicompost, which provides not only nitrogen but also enriches the soil with organic carbon, micronutrients, and beneficial microorganisms that collectively promote better plant vigour and fibre synthesis (Ghosh *et al.*, 2023) [9].

Treatment T_4, which involved 60 kg N ha^{-1} via vermicompost to *G. hirsutum* cultivar Chetna J1, also demonstrated a relatively high fibre strength (31.87 g tex^{-1}), statistically comparable to T_7. This suggests that both moderate and slightly elevated nitrogen levels through vermicompost can effectively enhance fibre strength in *G. hirsutum* cultivars. The fibre strength in T_4 was approximately 7.3% greater than in T_2, highlighting the role of cultivar selection and the positive response of *G. hirsutum* genotypes to organic nutrient application.

The positive influence of vermicompost on fibre strength could be ascribed to its role in gradually releasing nutrients and improving cation exchange capacity, thereby sustaining nutrient availability throughout the crop growth period (Yadav *et al.*, 2021) [45]. Vermicompost also enhances enzymatic activities and hormone-like substances (auxins, gibberellins) that contribute to improved boll development and fibre formation (Singh *et al.*, 2020) [38]. Moreover, the organic matter present in vermicompost contributes to better water retention, which can be critical in maintaining physiological turgor pressure essential for fibre elongation and thickening stages (Patil & Rajput, 2024) [28].

The inferior performance of the T_2 treatment (29.97 g tex^{-1}) may be a result of genotype limitations of the Arboreum cultivar (AVC 14), which generally produces coarser and

shorter fibres with lower strength compared to Hirsutum (Basal *et al.*, 2022) [5]. It is also plausible that despite receiving a higher nitrogen dose, the efficiency of nutrient uptake and assimilation into fibre biomass in Arboreum was less optimal than in Hirsutum genotypes.

The standard error (SE±0.31) and critical difference at 5% (CD = 0.49) further support the significance of differences among treatments, particularly between T_2 and T_7, indicating a true effect of genotype and organic nitrogen level interactions.

3.1.3 Micronaire (4.24 µg inch^{-1})

Micronaire is a critical parameter used to evaluate cotton fibre quality, representing both fibre fineness and maturity. It directly influences spinning performance, dye uptake, and the overall quality of the textile product (Haq *et al.*, 2022) [12]. Higher micronaire values are generally indicative of coarser or more mature fibres, while lower values reflect finer or potentially immature fibres. Hence, an optimal micronaire range is essential for producing high-quality yarn.

In the present study, the micronaire values among different treatments varied from 4.14 to 4.24 µg inch^{-1} (Table 2). According to standard micronaire classification, all values fell within the "average" category (very fine: <3.0; fine: 3.0-3.9; average: 4.0-4.9; coarse: 5.0-5.9; very coarse: >6.0), indicating moderate fibre maturity and fineness across treatments. The highest micronaire values (4.24 µg inch^{-1}) were recorded in treatments T_1 and T_2, both of which were associated with the *Gossypium arboreum* cultivar AVC 14. The lowest value (4.14 µg inch^{-1}) was observed in T_4, corresponding to the *G. hirsutum* cultivar Chetna J1 receiving 60 kg N ha^{-1} through vermicompost.

Statistical analysis revealed that these differences were not significant, suggesting that the application of vermicompost, irrespective of nitrogen level or cultivar, did not exert a marked effect on micronaire. This aligns with findings reported by Sharma *et al.* (2023) [9], who noted that organic nutrient sources, including vermicompost, may have limited or inconsistent effects on fibre fineness, particularly when soil fertility is adequate and genotypic traits predominate.

The similarity in micronaire values across treatments may largely be attributed to the intrinsic genetic characteristics of the cultivars used, as fibre fineness and maturity are strongly influenced by genotype (Kumar *et al.*, 2021) [2, 21]. The consistency of micronaire values across treatments also highlights the suitability of vermicompost as a stable nutrient source that does not compromise fibre maturity or fineness in organic cotton production systems.

3.1.4 Uniformity ratio

Uniformity ratio and elongation percentage are important fibre quality traits that collectively influence the spinning performance and durability of yarn. The uniformity ratio, defined as the ratio of 50% span length to 2.5% span length, reflects the consistency in fibre length distribution. A higher uniformity ratio suggests a lower proportion of short fibres and a more uniform fibre staple, which contributes to improved yarn evenness and processing efficiency (Islam *et al.*, 2021) [14]. Elongation percentage, indicates the fibre's elasticity and tensile strength, with higher values typically associated with better resilience during spinning and handling (Yuan *et al.*, 2023) [47].

Uniformity ratios among treatments ranged from 82.33% to 84.35%, and all values fell within the medium uniformity range (75-85%) according to standard classification (Table 2). The highest uniformity ratio (84.35%) was recorded in treatment T_8, followed closely by T_7 (84.20%) and T_4 (83.82%), all involving *Gossypium hirsutum* cultivars treated with varying doses of nitrogen via vermicompost. In contrast, the lowest value (82.33%) was observed in T_1, which included the Arboreum cultivar AVC 14. However, the variation across treatments was statistically non-significant, as indicated by the critical difference (CD) values.

The lack of significant differences suggests that while vermicompost application may influence overall plant vigour and fibre development, its impact on fibre length uniformity is limited under the experimental conditions. This aligns with the findings of Meena *et al.* (2022) [22], who reported that genotype plays a more crucial role than fertilization in determining fibre uniformity. Furthermore, Hirsutum cultivars, known for their superior fibre attributes compared to Arboreum, consistently exhibited higher uniformity ratios.

Similarly, elongation percentages ranged from 5.78% to 6.12%, with the maximum observed in T_4 (6.12%), involving a Hirsutum cultivar (Chetna J1) under 60 kg N ha^{-1} vermicompost. The minimum elongation (5.78%) was recorded in T_1 (Arboreum-AVC 14). Despite these differences, statistical analysis showed no significant treatment effects, consistent with prior observations by Reddy *et al.* (2020) [31], who reported that while organic amendments improve soil biological health and nutrient availability, they do not drastically influence fibre mechanical properties such as elongation.

The consistently moderate elongation values across treatments suggest stable fibre elasticity, likely resulting from the balanced nutrient release offered by vermicompost without abrupt vegetative stress, which can otherwise alter fibre cell wall development (Patel *et al.*, 2021) [27].

These results are in conformity with the findings of Sarkar and Majumdar (2002) [36] he reported that, application of 10 t FYM ha^{-1} improved the 2.5% span length (1.51%), uniformity ratio (1.07%), fibre fineness (1.09%), maturity (0.82%) and ginning out turn (3.51%) along with an increase in pooled lint yield by 15.36% over the no farmyard manure treatment.

3.1.5 Ginning percentage

Ginning percentage (GP), also known as ginning outturn (GOT), is a vital parameter in cotton production as it determines the proportion of lint obtained from seed cotton after ginning. It directly reflects the fiber yield potential and economic value of the cotton crop. A higher ginning percentage is typically desired as it indicates more lint output per unit of harvested seed cotton, contributing positively to marketable yield (Zhou *et al.*, 2022) [49].

Ginning percentage across treatments ranged from 34.0% (T_1) to 38.1% (T_4) (Table 3). Treatment T_4, which involved application of 60 kg N ha^{-1} through vermicompost to the Hirsutum cultivar (Chetna J1), recorded the highest ginning percentage (38.1%), whereas the lowest value (34.0%) was observed in T_1, involving 40 kg N ha^{-1} vermicompost applied to Arboreum cultivar (AVC 14). Despite these differences, statistical analysis indicated that the influence of treatments was non-significant (CD at 5% NS),

suggesting that variation in vermicompost-based nitrogen levels and cultivar types had a limited effect on lint yield efficiency.

These findings are in agreement with Kubde (1985), who observed that while higher nitrogen doses (50 and 75 kg N ha⁻¹) marginally increased ginning percentage over lower doses, the improvement was not always significant. Similarly, Oliveira *et al.* (1985) [24] reported that the combined application of NPK and organic manure had no substantial impact on GOT or fibre length, indicating that while nutrient management enhances overall biomass and yield, its direct influence on lint-to-seed ratio remains variable.

Ginning percentage is predominantly governed by genotypic traits, with varietal differences playing a more decisive role than external nutrient inputs. Treatments involving *Gossypium hirsutum* cultivars consistently exhibited higher GP values compared to *G. arboreum*, aligning with observations from Tomar *et al.* (2000) [42], who reported improved fibre yield characteristics, including seed and lint index, under high fertility regimes but attributed much of the variation to genotype. Patel *et al.* (2022) [26] observed no significant effect of organic amendments, including vermicompost, on ginning percentage when adequate soil fertility and varietal adaptability were present. Likewise, Mohan *et al.* (2023) [23] highlighted that while organic nutrient sources improve fibre quality and soil biological properties, traits such as GOT exhibit low responsiveness due to their genetic control.

Table 3: Effect of varying levels of nitrogen through vermicompost on Ginning percentage, Lint index of cotton in soils

Treatments	Ginning percentage	Lint index
T_1	34.00	2.41
T_2	37.92	3.16
T_3	37.00	3.1
T_4	38.1	3.44
T_5	35.12	2.74
T_6	36.45	3.09
T_7	34.56	2.62
T_8	35.70	2.86
SE (m)±	1.45	0.175
CD at 5%	NS	NS

3.1.6 Lint index

The lint index is a crucial metric in cotton fiber evaluation, representing the weight of lint per 100 seeds and serving as an indirect indicator of fiber yield potential. It plays a significant role in determining the economic return from cotton cultivation and reflects both genotypic potential and the influence of agronomic inputs (Zhou *et al.*, 2021) [50]. A higher lint index is generally associated with improved spinning value and increased profitability for cotton growers. The lint index across treatments ranged from 2.41 to 3.44 g (Table 3). The highest lint index (3.44 g) was observed in T_4, which involved application of 60 kg N ha⁻¹ through vermicompost to the Hirsutum cultivar Chetna J1, while the lowest value (2.41 g) was recorded in T_1, which received 40 kg N ha⁻¹ through vermicompost to the Arboreum cultivar AVC 14. Despite these observable differences, statistical analysis revealed that the treatment effects were non-significant (CD at 5%: NS).

These results are consistent with the findings of Tomar *et al.* (2000) [42], who reported increased lint and seed indices at higher fertility levels, particularly with balanced application of nitrogen, phosphorus, and potassium. Similarly, Khawale and Prasad (2001) [17] demonstrated that application of 80 kg N ha⁻¹ resulted in improved ginning percentage, seed index, and lint index, particularly under conditions of adequate soil fertility.

The higher lint index recorded in treatments involving *G. hirsutum* cultivars, especially under higher nitrogen levels through vermicompost (T_4 and T_2), aligns with existing literature suggesting that genotype exerts a primary influence on fibre yield parameters (Khan *et al.*, 2022) [16]. *G. hirsutum* is generally known to produce more lint per unit seed compared to *G. arboreum*, which often has finer but less abundant lint (Basal *et al.*, 2021) [6].

Bhatt *et al.* (2023) [7] reported that organic amendments improved overall crop health and fibre characteristics but had inconsistent effects on yield components like lint index due to overriding genetic control. Furthermore, the non-significant differences observed across treatments may also be attributed to stable soil fertility conditions and adequate baseline nutrient availability, reducing the relative responsiveness of the crop to varying nitrogen levels through organic sources (Rani *et al.*, 2022) [30].

4. Conclusions

The present study highlights the beneficial effects of organic nutrient management using vermicompost on fibre quality traits in cotton. Application of 60 kg N ha⁻¹ through vermicompost to *Gossypium hirsutum* cv. Chetna J1 (T_4) consistently resulted in superior fibre properties. Among the measured parameters, staple length and fibre strength showed statistically significant improvements, while traits such as micronaire value, uniformity ratio, elongation, ginning percentage, and lint index remained unaffected by treatment, suggesting a stronger genetic influence on these traits. The enhanced fibre quality observed in T_4 can be attributed to the slow-release nature of vermicompost, which ensures continuous nutrient supply, promoting sustained growth and fibre development. Moreover, *G. hirsutum* genotypes outperformed *G. arboreum* under organic conditions, indicating their greater adaptability and potential for quality improvement. These findings underscore the importance of integrating vermicompost into nutrient management practices, particularly under Vertisol conditions, and support its role in sustainable cotton production. Long-term research is recommended to further validate the consistency and wider applicability of these results in organic cotton production systems.

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