



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; 9(6): 981-985
Received: 05-03-2026
Accepted: 11-04-2026

Mori BJ
Ph.D. Scholar, Department of Soil
Science and Agricultural
Chemistry, College of Agriculture,
JAU, Junagadh, Gujarat, India

Sakarvadia HL
Professor and Head, Department
of Soil Science and Agricultural
Chemistry, College of Agriculture,
JAU, Junagadh, Gujarat, India

Bhuriya KP
Assistant Professor, Department of
Soil Science and Agricultural
Chemistry, College of Agriculture,
JAU, Junagadh, Gujarat, India

Parmar RM
Assistant Professor, Polytechnic in
Agriculture, JAU, Halvad,
Gujarat, India

Corresponding Author:

Mori BJ
Ph.D. Scholar, Department of Soil
Science and Agricultural
Chemistry, College of Agriculture,
JAU, Junagadh, Gujarat, India

Effect of Nano DAP on nutrient content and uptake by *Bt. cotton (Gossypium hirsutum L.)*

Mori BJ, Sakarvadia HL, Bhuriya KP and Parmar RM

DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i6m.5813>

Abstract

A field experiment was conducted at the Polytechnic in Agriculture, JAU, Halvad during the *Kharif* season of 2023 and 2024 to study the effect of Nano DAP on nutrient content and uptake by *Bt. Cotton (Gossypium hirsutum L.)*. The experiment comprised of twelve treatments viz., T₁: absolute control, T₂: 100% RDF i.e. 180-37.5-112.5 kg N-P₂O₅-K₂O ha⁻¹, T₃: 75% RDF + seed treatment with Nano DAP 7.5 mL kg⁻¹ of seed, T₄: 50% RDF + seed treatment with Nano DAP 7.5 mL kg⁻¹ of seed, T₅: 75% RDF + seed treatment with Nano DAP 7.5 mL kg⁻¹ of seed + foliar spray of Nano DAP 3 mL L⁻¹ of water at 30, 45 and 60 DAS, T₆: 50% RDF + seed treatment with Nano DAP 7.5 mL kg⁻¹ of seed + foliar spray of Nano DAP 3 mL L⁻¹ of water at 30, 45 and 60 DAS, T₇: 75% RDF + seed treatment with Nano DAP 7.5 mL kg⁻¹ of seed + foliar spray of Nano DAP 6 mL L⁻¹ of water at 30, 45 and 60 DAS, T₈: 50% RDF + seed treatment with Nano DAP 7.5 mL kg⁻¹ of seed + foliar spray of Nano DAP 6 mL L⁻¹ of water at 30, 45 and 60 DAS, T₉: 75% RDF + foliar spray of Nano DAP 3 mL L⁻¹ of water at 30, 45, 60 and 75 DAS, T₁₀: 50% RDF + foliar spray of Nano DAP 3 mL L⁻¹ of water at 30, 45, 60 and 75 DAS, T₁₁: 75% RDF + foliar spray of Nano DAP 6 mL L⁻¹ of water at 30, 45, 60 and 75 DAS, T₁₂: 50% RDF + foliar spray of Nano DAP 6 mL L⁻¹ of water at 30, 45, 60 and 75 DAS in Randomized block design and replicated thrice. The concentration and uptake of major nutrients (N, P and K) in *Bt. cotton* were significantly influenced by different Nano DAP treatments. Among all treatments, treatment T₇ (75% RDF + seed treatment with Nano DAP 7.5 mL kg⁻¹ of seed + foliar spray of Nano DAP 6 mL L⁻¹ of water at 30, 45 and 60 DAS) recorded the highest nutrient content in seed (3.86% N, 0.570% P and 1.70% K) and stalk (0.918% N, 0.289% P and 0.900% K). The same treatment also resulted in maximum nutrient uptake by cotton seed (95.19 kg N, 14.06 kg P and 41.81 kg K ha⁻¹) and cotton stalk (43.66 kg N, 13.75 kg P and 42.78 kg K ha⁻¹) and observed statistically at par with treatments T₂, T₅ and T₁₁. These results indicate that integration of 75% RDF with Nano DAP seed treatment and foliar application enhanced nutrient absorption, accumulation and utilization efficiency in *Bt. cotton*, while offering the possibility of reducing conventional fertilizer use by 25%.

Keywords: Nano DAP, *Bt. cotton*, *Gossypium hirsutum L.*, nutrient content

Introduction

Cotton (*Gossypium hirsutum L.*) is an important commercial crop grown in various environments for its high quality fiber and oil. It is a *kharif* (monsoon) crop in India, predominantly grown in warm climates with moderate rainfall and well drained black cotton soils rich in calcium and organic matter. Cotton is primarily cultivated for its fiber (lint) which is spun into yarn and fabric but its by-products such as cottonseed oil, meal and hulls are also economically valuable in agriculture and industry. Among the four cultivated species *G. hirsutum* (*Bt. cotton*) occupies over 90% of the cotton growing area in India due to its higher yield potential and resistance to bollworms (Kranthi, 2016) [6]. It is known as the American cotton and most popular varieties and hybrids now under cultivation. Nitrogen is a fundamental element of protein production and is very important for healthy growth of cotton and its physiological development. It is also a key component in chlorophyll production and therefore influences the plant's ability to produce carbohydrates. Simultaneously, Phosphorus (P) is crucial regarding energy transfer, root development and promoting flowering and fruiting. The ideal balance between nitrogen and phosphorus is crucial for supporting plant growth at various stages of development. The application of Nanotechnology in fertilizer is the best alternative to increase nutrient use efficiency. Nanotechnology has provided the feasibility of exploiting nanoscale or nanostructured

materials as fertilizer carriers or controlled release of nutrients so called “smart fertilizer” as new facilities to enhance nutrient use efficiency and reduce costs of environmental protection (Veronica *et al.*, 2015) [11]. Nano fertilizer increases fertilizer use efficiency by targeted release of nutrient in adequate proportion without any harmful effect on soil in addition to plant (Rameshaiah *et al.*, 2015) [7]. One such breakthrough application is the use of Nano-diammonium phosphate (Nano DAP) in cotton crops. The incorporation of Nano DAP in cotton crop management brings forth significant improvements in plant growth and development. This ensures that the plants receive the required nutrients at the right time resulting in enhanced overall growth, increased biomass production and improved resistance to biotic and abiotic stresses. Use of Nano DAP can lead to a significant increase in cotton yield by promoting higher flower retention, boll formation and improved fiber quality.

Materials and Methods

A field experiment was conducted during during the *Kharif* season of 2023 and 2024 at the Instructional Farm, Polytechnic in Agriculture, Junagadh Agricultural University, Halvad. The soil of the field was sandy loam in texture and slightly alkaline in reaction and which was found low in available N (215 and 225 kg ha⁻¹), medium in OC (0.58 and 0.61%), available P₂O₅ (28 and 31 kg ha⁻¹), S (18.20 and 19.80 ppm), Fe (6.95 and 7.15 ppm) and Zn (0.72 and 0.76 ppm) while, high in available K₂O (455 and 425 kg ha⁻¹), Mn (19.50 & 20.36 ppm) and Cu (1.10 & 1.16 ppm) during year 2023 and 2024, respectively. Three times replicated experiment in randomized block design (RBD) consisted of treatment T₁ served as an absolute control. Treatment T₂ received the full RDF comprising 180 kg N, 37.5 kg P₂O₅ and 112.5 kg K₂O ha⁻¹. Treatments T₃ and T₄ involved application of 75% and 50% RDF, respectively combined with seed treatment using Nano DAP 7.5 mL per kg of seed. Treatments T₅ and T₆ received 75% and 50% RDF respectively, with seed treatment of Nano DAP 7.5 mL kg⁻¹ seed along with foliar sprays of Nano DAP 3 mL L⁻¹ of water at 30, 45 and 60 days after sowing (DAS). Similarly, treatments T₇ and T₈ received 75% and 50% RDF respectively, seed treatment with Nano DAP 7.5 mL kg⁻¹ seed and foliar sprays of Nano DAP 6 mL L⁻¹ of water at 30, 45, and 60 DAS. In treatments T₉ and T₁₀ 75% and 50% RDF were applied respectively, along with foliar applications of Nano DAP 3 mL L⁻¹ of water at 30, 45, 60 and 75 DAS. Treatments T₁₁ and T₁₂ included 75% and 50% RDF respectively, with foliar application of Nano DAP 6 mL L⁻¹ of water at 30, 45, 60 and 75 DAS. These treatment combinations were carefully designed to evaluate the synergistic effects of reduced chemical fertilizer doses with Nano DAP through seed treatment and/or foliar applications on growth, yield and nutrient accumulation in *Bt.* cotton. The nutrients of N, P and K were applied through source of urea, DAP and MOP, respectively and *Bt.* cotton hybrid (G.Cot.Hy.24 BG II) was sown with seed rate of 3.0 kg ha⁻¹ at inter row spacing of 120 cm and intra row spacing of 45 cm in order to obtain uniform plant stand.

Results and Discussion

1. Effect of Nano DAP on nitrogen content and uptake by seed and stalk

The finding expressed in Table 1 and 2 revealed that N content in seed and stalk of *Bt.* cotton significantly exhibited marked variation by different Nano DAP treatments during both the years and in pooled analysis. The application of 75% RDF + seed treatment with Nano DAP 7.5 mL kg⁻¹ + foliar spray of Nano DAP 6 mL L⁻¹ at 30, 45 and 60 DAS (T₇) evidently recorded the highest N content in seed (3.88, 3.84 and 3.86%) and stalk (0.912, 0.925 and 0.918%) and also it remained at par with treatments T₂, T₅ and T₁₁ during both the year and pooled, respectively. The

observed increase of nitrogen content in seed and stalk is consistent with the conclusions drawn by Attia *et al.* (2016) [2], who suggested that nitrogen content in plant parts significantly increased by each increment of Nano fertilizer. The treatment with Nano N at 2.5 times reduced recommended dose recorded the highest N content in grain and straw of sorghum as also reported by Rani *et al.* (2019) [8]. Table 3 and 4 presents the effect of Nano DAP on nitrogen uptake (kg ha⁻¹) by seed and stalk of *Bt.* cotton at harvest during both the years and pooled results. The highest uptake of N by seed (96.85 kg ha⁻¹ and 93.53 kg ha⁻¹) observed with application of 75% RDF + seed treatment with Nano DAP 7.5 mL kg⁻¹ + foliar spray of Nano DAP 6 mL L⁻¹ at 30, 45 and 60 DAS (T₇) and it was statistically comparable with treatments T₅ (87.67 kg ha⁻¹ and 84.86 kg ha⁻¹) and T₂ (87.02 kg ha⁻¹ and 84.54 kg ha⁻¹) during both years. The pooled data also revealed that T₇ performed better with highest N uptake (95.19 kg ha⁻¹) by seed among all treatments and it was found on par with T₅ (86.27 kg ha⁻¹). In both the year and pooled analysis least uptake of N by seed was noted under T₁ with 49.27, 44.07 and 46.67 kg ha⁻¹, respectively. N uptake by cotton stalk at harvest was exhibited lowest (22.97, 24.07 and 23.52 kg ha⁻¹) under absolute control (T₁) to highest (44.52, 42.79 and 43.66 kg ha⁻¹) under treatment T₇ in both year and pooled, respectively. During first season and second season, treatment T₇ was observed statistically at par with treatments T₂ (38.81 and 38.91 kg ha⁻¹) and T₅ (38.45 and 40.29 kg ha⁻¹), respectively. Similar trend was observed by Hemdan *et al.* (2020) [5], who showed maximum uptake of nitrogen in plant with nano fertilizer application. Abouyouseff *et al.* (2022) [1] reported that application of NPK nano fertilizers led to increase in nutrient uptake in plant.

2. Effect of Nano DAP on phosphorus content and uptake by seed and stalk

A perusal of data furnished in Table 1 exhibits that P content in seed was significantly influenced by different treatments involving reduced RDF with Nano DAP application through seed treatment and foliar spray at different periods. Among all treatments, Treatment T₇ comprising 75% RDF + seed treatment with Nano DAP 7.5 mL kg⁻¹ + foliar spray of Nano DAP 6 mL L⁻¹ at 30, 45 and 60 DAS recorded the significantly highest phosphorus content in seed as 0.573, 0.567 and 0.570% during 2023, 2024 and pooled, respectively. Treatments T₂ (0.525 and 0.523%) and T₁₁ (0.524 and 0.523%) was found at par with T₇ (in 2023 and 2024). While, treatment T₅ (0.534, 0.566 and 0.550%) noticed at par with T₇ in both years as well as in pooled data, respectively. The least P content (0.438, 0.463 and 0.451% in 2023, 2024 and pooled, respectively) was detected in T₁ as absolute control. The data presented in Table 2 indicated that phosphorus content in stalk of *Bt.* cotton at harvest was significantly influenced by different evaluated treatments. During 2023, the maximum P content (0.290%) in cotton stalk was examined under T₇ with application of 75% RDF + seed treatment with Nano DAP 7.5 mL/kg seed + foliar spray of Nano DAP 6 mL/L at 30, 45 and 60 DAS which was significantly superior over most of the treatments but remained at par with T₂ (0.264%), T₅ (0.276%) and T₁₁ (0.267%). In 2024, a parallel trend was noticed where T₇ further recorded the highest phosphorus content (0.287%) in stalk, succeeded by T₁₁ (0.259%), T₂ (0.265%) and T₅ (0.267%). In pooled data, T₇ maintained its superiority with 0.289% P content in stalk, which was at par with T₅ (0.272%). The minimal P content in stalk was examined under plot as absolute control (T₁) with value of 0.234% in 2023, 0.226% in 2024 and 0.230% in pooled year data. In aggrement with the current findings Chinnappa *et al.* (2023) [3] and Veeramallu *et al.* (2024) [10] demonstrated that nano fertilizer foliar application enhanced NUE and nutrient accumulation in crops. The results

presented in Table 3 indicated that in seed of *Bt.* cotton the phosphorus uptake was reported greater through application of 75% RDF + seed treatment with Nano DAP 7.5 mL kg⁻¹ seed + foliar spray of Nano DAP 6 mL L⁻¹ at 30, 45 and 60 DAS (T₇) during 2023 (14.32 kg ha⁻¹), 2024 (13.79 kg ha⁻¹) and pooled (14.06 kg ha⁻¹) among all treatments evaluated. The lowest seed phosphorus uptake was noted under T₁: absolute control as 6.40, 6.17 and 6.28 kg ha⁻¹ in the year 2023, 2024 and pooled, respectively. Treatments T₅ (12.73 kg ha⁻¹) and T₂ (11.84 kg ha⁻¹) both expressed equivalent with T₇ during 2024 in respect to P uptake by seed. The data reported in Table 4 revealed that phosphorus uptake by stalk was significantly highest as 14.18, 13.31 and 13.75 kg ha⁻¹ during 2023, 2024 and pooled, respectively with the application of 75% RDF + seed treatment with Nano DAP 7.5 mL kg⁻¹ seed + foliar spray of Nano DAP 6 mL L⁻¹ at 30, 45 and 60 DAS (T₇). It was remained at par with T₅ (12.12 kg ha⁻¹ in 2023 and 12.16 kg ha⁻¹ in 2024) and T₂ (11.77 kg ha⁻¹ in 2024). The lowest P uptake by stalk was registered with T₁: absolute control (7.40, 6.97 and 7.18 kg ha⁻¹ in first year, second year and pooled, respectively). The increased phosphorus uptake under integrated treatments may be ascribed to enhanced phosphorus mobility, improved root proliferation and greater nutrient assimilation efficiency facilitated by nano sized particles (Tomar *et al.*, 2024) [9].

3. Effect of Nano DAP on potassium content and uptake by seed and stalk

The summary of data accessible in Table 1 revealed that during 2023, K content in seed ranged from minimal 1.47% (T₁: Absolute control) to largest 1.71% (T₇: 75% RDF + seed treatment with Nano DAP 7.5 mL kg⁻¹ seed + foliar spray of Nano DAP 6 mL L⁻¹ at 30, 45 and 60 DAS) while in 2024 it varied from minimum 1.45% (T₁) to maximum 1.70% (T₇). Treatment T₇ also found statistically comparable with treatments T₂ (1.66 and 1.63%), T₅ (1.65 and 1.63%) and T₁₁ (1.65 and 1.64%) in respective both the years. On a pooled basis, treatment T₇ had the highest potassium content (1.70%) in seed, which was considerably better than the other treatments and statistically comparable to T₂ (1.65%), T₅ (1.64%), and T₁₁ (1.64%). The seed K content under T₁ (absolute control) found the lowest (1.46% pooled). The maximum potassium content (0.909%) in cotton stalk (Table 2) during 2023 was found by application of 75% RDF

+ seed treatment with Nano DAP 7.5 mL kg⁻¹ seed + foliar spray of Nano DAP 6 mL L⁻¹ at 30, 45 and 60 DAS (T₇) and it was statistically on par with T₂ (0.866%), T₅ (0.852%) and T₁₁ (0.856%). During 2024, K content (0.891%) in stalk was observed maximum through treatment T₇ and it remained on par with T₁₁ (0.859%), T₂ (0.849%) and T₅ (0.844%). The pooled data expressed highest K content (0.900%) in stalk through treatment T₇, which was superior over all treatments but statistically at par with T₂ (0.858%), T₁₁ (0.857%) and T₅ (0.848%). The lowest potassium content in stalk during 2023 (0.735%), 2024 (0.730%) and pooled (0.733%) was observed with absolute control (T₁). Data presented in Table 3 revealed that during 2023, significantly maximum K uptake of 42.54 kg ha⁻¹ by seed was recorded under application of 75% RDF + seed treatment with Nano DAP 7.5 mL kg⁻¹ seed + foliar spray of Nano DAP 6 mL L⁻¹ at 30, 45 and 60 DAS (T₇), which remained at par with T₂: 100% RDF and T₅: 75% RDF + seed treatment with Nano DAP 7.5 mL/kg + foliar spray of Nano DAP 3 mL/L at 30, 45 and 60 DAS. A trend was registered similar in 2024, wherein K uptake by seed was registered highest (41.09 kg ha⁻¹) under treatment T₇ followed by T₅ (36.73 kg ha⁻¹) and T₂ (36.57 kg ha⁻¹). In pooled analysis, T₇ remained maximum with K uptake of 41.81 kg ha⁻¹ which was superior over remaining treatments (Table 3). The uptake of potassium by seed was observed lowest in treatment T₁: absolute control during 2023, 2024 and pooled year (21.60, 19.00 and 20.30 kg ha⁻¹, respectively). The data allocated in Table 4 declared that potassium uptake by stalk was significantly influenced by different treatments in both the years and in pooled results. Among all treatments, treatment T₇ (75% RDF + seed treatment with Nano DAP 7.5 mL kg⁻¹ seed + foliar spray of Nano DAP 6 mL L⁻¹ at 30, 45 and 60 DAS) recorded the highest K uptake by stalk (44.41 and 41.15 kg ha⁻¹ during 2023 and 2024, respectively) with a pooled mean of 42.78 kg ha⁻¹, which was statistically at par with T₂ (37.61 kg ha⁻¹) and T₅ (38.45 kg ha⁻¹) in 2024. The absolute control (T₁) registered the minimum K uptake (22.67 kg ha⁻¹ pooled). Adequate N and P from Nano DAP improves the functionality of K⁺ transport proteins and membrane permeability facilitating efficient K uptake and its redistribution within plant tissues (Chinnappa *et al.*, 2023) [3]. The nano formulation further increases NUE by minimizing fixation and improving nutrient availability at the cellular level (Gousia *et al.*, 2023) [4].

Table 1: Effect of Nano DAP on N, P and K content in seed of *Bt.* cotton at harvest

Treatment	N content (%) in seed			P content (%) in seed			K content (%) in seed		
	2023	2024	Pooled	2023	2024	Pooled	2023	2024	Pooled
T ₁	3.34	3.32	3.33	0.438	0.463	0.451	1.47	1.45	1.46
T ₂	3.79	3.75	3.77	0.525	0.523	0.524	1.66	1.63	1.65
T ₃	3.40	3.50	3.45	0.481	0.494	0.488	1.50	1.49	1.49
T ₄	3.39	3.48	3.44	0.490	0.474	0.482	1.47	1.46	1.47
T ₅	3.80	3.76	3.78	0.534	0.566	0.550	1.65	1.63	1.64
T ₆	3.49	3.45	3.47	0.499	0.487	0.493	1.51	1.48	1.50
T ₇	3.88	3.84	3.86	0.573	0.567	0.570	1.71	1.70	1.70
T ₈	3.41	3.45	3.43	0.501	0.492	0.497	1.51	1.53	1.52
T ₉	3.40	3.43	3.42	0.501	0.489	0.495	1.53	1.50	1.51
T ₁₀	3.48	3.44	3.46	0.494	0.475	0.485	1.50	1.48	1.49
T ₁₁	3.76	3.69	3.73	0.524	0.523	0.523	1.65	1.64	1.64
T ₁₂	3.49	3.44	3.46	0.497	0.478	0.487	1.53	1.51	1.52
S.Em.±	0.13	0.11	0.08	0.021	0.022	0.015	0.06	0.06	0.04
C.D. at 5%	0.38	0.32	0.24	0.063	0.066	0.044	0.17	0.17	0.11
C.V.%	6.28	5.38	5.84	7.31	7.72	7.52	6.27	6.35	6.31
Y									
S.Em.±			0.03			0.006			0.02
C.D. at 5%			NS			NS			NS
Y × T									
S.Em.±			0.12			0.022			0.06
C.D. at 5%			NS			NS			NS

Table 2: Effect of Nano DAP on N, P and K content in stalk of *Bt.* cotton at harvest

Treatment	N content (%) in stalk			P content (%) in stalk			K content (%) in stalk		
	2023	2024	Pooled	2023	2024	Pooled	2023	2024	Pooled
T ₁	0.738	0.782	0.760	0.234	0.226	0.230	0.735	0.730	0.733
T ₂	0.886	0.878	0.882	0.264	0.265	0.265	0.866	0.849	0.858
T ₃	0.780	0.796	0.788	0.252	0.249	0.250	0.758	0.756	0.757
T ₄	0.798	0.816	0.807	0.253	0.236	0.245	0.773	0.749	0.761
T ₅	0.874	0.885	0.880	0.276	0.267	0.272	0.852	0.844	0.848
T ₆	0.795	0.820	0.808	0.252	0.244	0.248	0.768	0.774	0.771
T ₇	0.912	0.925	0.918	0.290	0.287	0.289	0.909	0.891	0.900
T ₈	0.780	0.752	0.766	0.230	0.246	0.238	0.787	0.783	0.785
T ₉	0.800	0.799	0.799	0.254	0.250	0.252	0.799	0.775	0.787
T ₁₀	0.762	0.801	0.782	0.234	0.237	0.235	0.785	0.756	0.771
T ₁₁	0.878	0.876	0.877	0.267	0.259	0.263	0.856	0.859	0.857
T ₁₂	0.795	0.814	0.805	0.254	0.243	0.249	0.789	0.784	0.787
S.Em.±	0.036	0.034	0.025	0.011	0.011	0.008	0.035	0.033	0.024
C.D. at 5%	0.104	0.099	0.070	0.033	0.033	0.023	0.102	0.097	0.068
C.V.%	7.55	7.05	7.30	7.66	7.65	7.66	7.43	7.20	7.32
Y									
S.Em.±			0.010			0.003			0.010
C.D. at 5%			NS			NS			NS
Y × T									
S.Em.±			0.035			0.011			0.034
C.D. at 5%			NS			NS			NS

Table 3: Effect of Nano DAP on N, P and K uptake by seed of *Bt.* cotton at harvest

Treatment	N uptake (kg/ha) by seed			P uptake (kg/ha) by seed			K uptake (kg/ha) by seed		
	2023	2024	Pooled	2023	2024	Pooled	2023	2024	Pooled
T ₁	49.27	44.07	46.67	6.40	6.17	6.28	21.60	19.00	20.30
T ₂	87.02	84.54	85.78	12.03	11.84	11.94	38.19	36.57	37.38
T ₃	67.65	69.19	68.42	9.59	9.75	9.67	29.71	29.47	29.59
T ₄	66.49	64.73	65.61	9.58	8.81	9.20	28.96	27.13	28.05
T ₅	87.67	84.86	86.27	12.32	12.73	12.52	38.16	36.73	37.44
T ₆	68.99	67.52	68.26	9.86	9.51	9.68	29.87	28.88	29.37
T ₇	96.85	93.53	95.19	14.32	13.79	14.06	42.54	41.09	41.81
T ₈	67.44	68.90	68.17	9.91	9.75	9.83	29.75	30.25	30.00
T ₉	67.81	68.74	68.28	9.97	9.84	9.90	30.43	29.92	30.17
T ₁₀	68.34	64.14	66.24	9.72	8.76	9.24	29.58	27.55	28.56
T ₁₁	75.07	74.57	74.82	10.46	10.55	10.50	32.89	33.16	33.03
T ₁₂	68.91	65.58	67.24	9.81	9.09	9.45	30.22	28.35	29.28
S.Em.±	3.74	4.98	3.12	0.58	0.71	0.46	1.66	1.93	1.27
C.D. at 5%	10.98	14.62	8.89	1.69	2.09	1.31	4.88	5.65	3.63
C.V.%	8.92	12.18	10.64	9.67	12.29	11.02	9.06	10.88	9.98
Y									
S.Em.±			1.27			0.19			0.52
C.D. at 5%			NS			NS			NS
Y × T									
S.Em.±			4.40			0.64			1.80
C.D. at 5%			NS			NS			NS

Table 4: Effect of Nano DAP on N, P and K uptake by stalk of *Bt.* cotton at harvest

Treatment	N uptake (kg/ha) by stalk			P uptake (kg/ha) by stalk			K uptake (kg/ha) by stalk		
	2023	2024	Pooled	2023	2024	Pooled	2023	2024	Pooled
T ₁	22.97	24.07	23.52	7.40	6.97	7.18	22.93	22.40	22.67
T ₂	38.81	38.91	38.86	11.58	11.77	11.67	38.02	37.61	37.81
T ₃	30.75	30.11	30.43	9.89	9.50	9.70	29.83	28.67	29.25
T ₄	32.06	31.59	31.82	10.14	9.13	9.64	31.21	29.01	30.11
T ₅	38.45	40.29	39.37	12.12	12.16	12.14	37.47	38.45	37.96
T ₆	30.71	30.53	30.62	9.72	9.06	9.39	29.59	28.79	29.19
T ₇	44.52	42.79	43.66	14.18	13.31	13.75	44.41	41.15	42.78
T ₈	30.13	28.51	29.32	8.88	9.33	9.10	30.41	29.68	30.04
T ₉	31.80	30.65	31.23	10.10	9.59	9.84	31.66	29.72	30.69
T ₁₀	28.75	29.44	29.09	8.73	8.70	8.71	29.39	27.70	28.54
T ₁₁	35.40	33.90	34.65	10.80	10.01	10.40	34.38	33.24	33.81
T ₁₂	29.90	30.07	29.99	9.59	8.92	9.26	29.69	29.01	29.35
S.Em.±	2.18	1.90	1.45	0.72	0.66	0.49	2.14	1.74	1.38

C.D. at 5%	6.40	5.58	4.13	2.11	1.94	1.39	6.29	5.11	3.94
C.V.%	11.50	10.12	10.84	12.13	11.63	11.89	11.46	9.64	10.62
Y									
S.Em.±			0.59			0.20			0.56
C.D. at 5%			NS			NS			NS
Y × T									
S.Em.±			2.04			0.69			1.95
C.D. at 5%			NS			NS			NS

Conclusion

On the basis of two years experimentation, the integrated use of 75% RDF + seed treatment with Nano DAP 7.5 mL kg⁻¹ seed + foliar spray 6 mL L⁻¹ at 30, 45 and 60 DAS exhibited its superiority in respect of major nutrient accumulation and their uptake by *Bt*. Cotton. Overall, the application of Nano DAP and reduced RDF level in integration plays a frontline role in greater nutrient content and uptake by *Bt*. cotton.

References

1. Abou-Youseff AM, Abou El-Khair RA, El-Mohtasem MO, Shawer SS. Impacts of nano-fertilizers and chemical fertilizers on plant growth and nutrient uptake by faba bean plant. *Al-Azhar Journal of Agricultural Research*. 2022;47(1):216–229.
2. Attia ANE, El-Hendi MH, Hamoda SAF, El-Sayed SOO. Effect of nano-fertilizer (Lithovit) and potassium on leaves chemical composition of Egyptian cotton under different planting dates. *Journal of Plant Production*. 2016;7(9):935–942.
3. Chinnappa SA, Krishnamurthy D, Ajayakumar MY, Ravi S. Response of nano-fertilizers on growth, yield and economics of kharif sorghum. *The Pharma Innovation Journal*. 2023;12(9):761–765.
4. Gousia SU, Ajayakumar MY, Krishnamurthy D, Kamble SA, Bhat SN. Effect of nano nitrogen on growth, yield and nutrient uptake of *Bt* cotton. *International Journal of Environment and Climate Change*. 2023;13(11):3705–3710.
5. Hemdan NA, Hussein MM, El-Ashry S. Conventional and nano-fertilizers and their effect on growth and nutrient status of lupine plants. *Current Science International*. 2020;9(4):698–705.
6. Kranthi KR. *Bt* cotton in India: a review of adoption, performance and sustainability. *Cotton Research Journal*. 2016;12(2):101–110.
7. Rameshaiah GN, Pallavi J, Shabnam S. Nano fertilizers and nano sensors—an attempt for developing smart agriculture. *International Journal of Engineering Research and General Science*. 2015;3(1):314–320.
8. Rani B, Zalawadia NM, Buha D, Kandolia R. Effect of different levels of chemical and nano nitrogenous fertilizers on content and uptake of N, P and K by sorghum cv. Gundari. *Journal of Pharmacognosy and Phytochemistry*. 2019;8(5):454–458.
9. Tomar M, Malgaya G, Dubey S, Singh A, Jalsingod J. Effect of Nano DAP on growth and yield performance of wheat (*Triticum aestivum* L.). *International Journal of Plant and Soil Science*. 2024;36(8):682–692.
10. Veeramallu J, Deshmukh MS, Pilewad SR. Studies on effect of Nano DAP on yield and nutrient uptake of soybean grown on Vertisol. *International Journal of Research in Agronomy*. 2024;7(10):672–677.
11. Veronica N, Guru T, Thatikunta R, Reddy NS. Role of nano-fertilizers in agricultural farming. *International Journal of Environmental Science and Technology*. 2015;1(1):1–3.