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Enhancing the Bt. Cotton Performance: Investigating the Impact of Nano DAP on Growth, Yield and Nnutrient Availability

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Abstract

A field investigation entitled "Yield, nutrient uptake and economics of Bt. cotton as influenced by foliar sprays of Nano DAP in Inceptisol" was conducted in kharif season of 2022- 2023 at the Instructional Farm, Post-Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri. The experiment was laid out in RBD with ten treatments and replications three times. All the growth contributing data viz., plant population (22860), per cent of plant count (92.54), plant height (139.40 cm), total number of branches plant^{-1} (22.40), number of bolls (103.70), were recorded significantly maximum under T_2 - DI with 100% RDF of NPK. All the yield contributing characters cotton yield (40.90 q ha^{-1}), lint yield (14.19 q ha^{-1}), (seed yield (26.71q ha^{-1}), Ginning % (34.70) were recorded significantly maximum under T_2 - DI with 100% RDF of NPK. The highest nutrient availability of nitrogen (163.70 kg ha^{-1}), phosphorous (16.90 kg ha^{-1}), potassium (468.30 kg ha^{-1}) were recorded significantly maximum under T_2 - DI with 100% RDF of NPK.

Key words : Foliar, significant.

Cotton is an important commercial crop of India grown under diverse agro-climatic conditions and play vital role in Indian economy. Popularly known as 'White Gold' and 'King of Fibre' contribute about 85 per cent of raw material to textile industries. It is grown in both irrigated as well as rainfed tracts and in rainfed areas yield of cotton mainly depends on timing and intensity of rainfall. The rainfed cotton frequently grown on shrink- swell type of soil. It is grown mainly for fibre production and seed yield is considered to be secondary importance.

Now days farmers are unable to gain maximum production of Bt. cotton as compared to area under cultivation due to several constraints viz. uneven distribution of rainfall throughout the growing period of cotton, imbalanced application of inorganic fertilizers without knowing soil nutrient status and nutrient requirement of cotton. In Bt. cotton due to synchronized boll development rapid translocation of nutrients toward bolls from the leaves occur causing deficiency of nutrients that's why it is necessary to supply optimum amount of macro and micronutrients to maximize the yield of Bt. cotton (Hebber *et al*. 2007). Foliar feeding is often effective when roots are unable to absorbs sufficient amount of nutrients from the soil due to soil moisture stress and higher degree of fixation at critical growth stages of Bt. cotton which would help to improve nutrient status in leaf. Considering the above fact the experiment was conducted to overcome this problem by foliar application of macro and micronutrients.

About 40 per cent of the worlds population experience water shortages (Hamdy and Hassabo, 2003; Steduto *et al*., 2017) and the misuse and mismanagement of available water resourses pose serious threats to sustainable development.

Large scale commercial cultivation of genetically modified high yielding hybrids of cotton, mostly in irrigated area has increased cotton cultivation to the extent of 9.59 m ha

during the last decade. But the productivity of cotton in India is still low (505 kg lint ha^{-1}) as against world average of 735 kg lint ha^{-1} (Nasrabad *et al*., 2013).

Material and Methods

A field investigation entitled " Yield, nutrient uptake and economics of Bt. cotton as influenced by foliar sprays of Nano DAP in Inceptisol" was conducted in kharif season of 2022- 2023 at the Instructional Farm, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri. The experiment consists of 10 treatments *viz*., The experiment comprised of T_1 - DI with no N, P and 100% RD of K (control), T_2 - DI with 100% RDF of NPK, T_3 - DI with 75% RDF of NPK, T_4 - DI with 50% RDF of NPK, T_5 - DI with T_3 + Seed Treatment + Foliar Spray of Nano DAP @ 2 ml lit^{-1} at 35 DAS, T_6 - DI with T_3 + Seed treatment + Foliar Spray of Nano DAP @ 4 ml lit^{-1} at 35 DAS, T_7 - DI with T_4 + ST + Foliar Spray of Nano DAP @ 2 ml lit^{-1} at 35 DAS, T_8 - DI with T_4 + ST + Foliar Spray of Nano DAP @ 4 ml lit^{-1} at 35 DAS, T_9 – DI with T_4 + ST + Foliar Sprays of Nano DAP @ 2 ml lit^{-1} at 35 and 55 DAS, T_{10} - DI with T_4 + ST + Foliar Sprays of Nano DAP @ 4 ml lit^{-1} at 35 and 55 DAS, (ST- Seed treatment with Nano DAP @ 5 ml kg^{-1} of seed, DAS- days after sowing). Bt. cotton crop was planted 0.90 m x 0.45 m spacing.

The fertilizers *viz*., urea, contain 46% of N, DAP (N:P=18:46), MOP containing 60 % K_2O, were applied as per the treatments. The recommended dose of fertilizer for Bt. cotton is 125:65:65 NPK kg ha^{-1}. The foliar sprays of Nano DAP was done 35 and 55 DAS. Periodical observations on the growth characters, yield contributing characters and nutrient availability.

Results and Discussion

(I) Growth Parameters : The plant population of any crop at the time of harvest is deciding factor of yield and functions of plant population at harvest per unit area and yield per plant. The highest plant count (22860 ha^{-1}), per cent of final plant count (92.58), plant height (139.40 cm), number of branches (22.40), number of bolls (103.70) were recorded significantly in treatment T_2 DI with 100% RDF

Table1. Growth contributing character of Bt. cotton as influenced by Nano DAP

Treatment	Growth contributing characters at harvest				
	Final plant count ha^{-1}	% of Final plant count	Plant height (cm)	No. of branches $plant^{-1}$	No of bolls
T_1 - No N and P; 100% RD of K (Control)	22200	89.91	130.00	15.23	80.00
T_2 - 100% RDF of NPK	22860	92.58	139.40	22.40	103.70
T_3 - 75% RDF of NPK	22650	91.75	136.67	20.33	96.00
T_4 - 50% RDF of NPK	22345	90.49	131.67	18.00	81.67
T_5 - T_3 + ST + Foliar spray of Nano DAP @ 2 ml lit^{-1} at 35 DAS	22795	92.32	137.00	20.83	97.33
T_6 - T_3 + ST + Foliar spray of Nano DAP @ 4 ml lit^{-1} at 35 DAS	22855	92.54	138.33	21.00	98.67
T_7 - T_4 + ST + Foliar spray of Nano DAP @ 2 ml lit^{-1} at 35 DAS	22295	90.29	132.00	19.00	85.00
T_8 - T_4 + ST+Foliar spray of Nano DAP @ 4 ml lit^{-1} at 35 DAS	22500	91.12	134.00	19.50	87.00
T_9 - T_4 + ST +Two foliar sprays of Nano DAP @ 2 ml lit^{-1} at 35 and 55 DAS	22562	91.37	134.33	19.67	88.33
T_{10} - T_4 + ST +Two foliar sprays of Nano DAP @ 4 ml lit^{-1} at 35 and 55 DAS	22595	91.51	136.00	20.07	92.00
S.E. m±	1.25	0.90	1.47	0.87	4.07
CD at 5%	NS	NS	4.40	2.60	12.20

of NPK, however, it was at par with 75% RDF and foliar spray of Nano DAP @ 4 ml lit^{-1} at 35 DAS (T_6),T_5 and T_{10}. These results are in close confirmation with the observations recorded by the Pawar *et al*. (2014), Jayakumar *et al*. (2014), Gousia *et al*. (2023) concluded that highest plant height, number of branches, number of bolls in Bt. cotton.

(II) Yield contributing characters : The yield and yield contributing characters *viz*. cotton yield (q ha^{-1}), lint yield (q ha^{-1}), seed yield (q ha^{-1}) and ginning percentage as influenced by foliar sprays of Nano DAP are presented in Table 2. The significantly maximum cotton yield (40.90 q ha^{-1}), lint yield (14.19 q ha^{-1}), seed yield (26.71 q ha^{-1}) of Bt. cotton were recorded in treatment T_2 i.e. 100% RD of NPK over all other treatments. However, it was at par with T_6 (75% RDF + ST + Foliar sprays of Nano DAP @ 4 ml lit^{-1} at 35 DAS). The per cent increase in yield due to application of foliar sprays of Nano DAP was maximum in T_6 (13.07%) over T_3 and in T_{10} (21.10%) over T_4.

Al-juthery *et al*. (2018) observed that foliar treatment is more effective than traditional fertilizers because it comes into direct touch with the leaves and is taken up by the target organs, resulting in a more targeted and immediate response. Nano fertilizers are more reactive and may pierce the cuticle, allowing for regulated release and delivery. Foliar feeding has been shown to be the most efficient way of correcting nutrient deficiencies and increasing crop yield and quality. Increase in yield was recorded due to various foliar sprays of Nano fertilizers when compared with conventional fertilizer application.

The minimum cotton yield (20.30 q ha^{-1}), lint yield (6.09 q ha^{-1}), seed yield (14.21 q ha^{-1}) and ginning Percentage (30.00%) were recorded in T_1 (Control no N and P and 100% K). The minimum yield characters due to lack of proper nutrition.

(III) Nutrient availability : The nutrient availability in soil was found to be influenced significantly due to application of foliar sprays of Nano DAP in different treatments.

The significantly maximum availability of N, P, K (163.70, 16.90, 468.3 kg ha^{-1}) was observed at treatment T_2 (100% RDF of NPK) at harvest because application of 100% recommended dose of fertilizers has increased nutrient availability. Treatment T_1 (No N and P; 100% RD of K (Control) recorded minimum availability of N and P i.e. 142.40, 10.70, kg

Table 2. Yield and yield contributing character of Bt. cotton as influenced by Nano DAP

Treatment	Cotton yield (q ha^{-1})	Lint yield (q ha^{-1})	Seed yield (q ha^{-1})	Ginning (%)
T_1 - No N and P; 100% RD of K (Control)	20.30	06.09	14.21	30.00
T_2 - 100% RDF of NPK	40.90	14.19	26.71	34.70
T_3 - 75% RDF of NPK	34.67	11.82	22.85	34.10
T_4 - 50% RDF of NPK	26.18	08.53	17.65	32.60
T_5 - T_3 + ST + Foliar spray of Nano DAP @ 2 ml lit^{-1} at 35 DAS	37.85	12.94	24.91	34.20
T_6 - T_3 + ST + Foliar spray of Nano DAP @ 4 ml lit^{-1} at 35 DAS	39.20	13.48	25.72	34.40
T_7 - T_4 + ST + Foliar spray of Nano DAP @ 2 ml lit^{-1} at 35 DAS	28.85	09.69	19.16	33.60
T_8 - T_4 + ST+Foliar spray of Nano DAP @ 4 ml lit^{-1} at 35DAS	30.50	10.28	20.22	33.70
T_9 - T_4 + ST +Two foliar sprays of Nano DAP @ 2 ml lit^{-1} at 35 and 55 DAS	31.05	10.50	20.55	33.81
T_{10} - T_4 + ST +Two foliar sprays of Nano DAP @ 4 ml lit^{-1} at 35 and 55 DAS	31.70	10.75	20.95	33.91
S.E. m ±	1.05	0.55	0.74	0.68
CD at 5%	3.13	1.64	2.22	NS

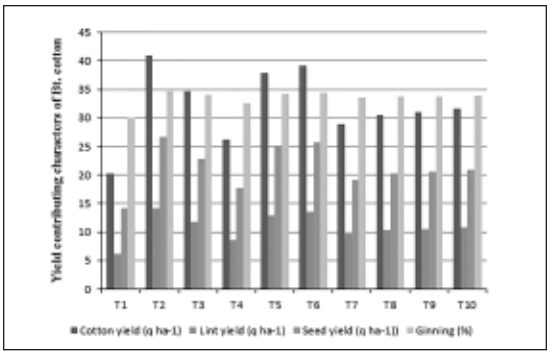

Fig. 1. Yield contributing characters of Bt. cotton

ha^{-1} and minimum K availability of 456.0 kg ha^{-1} was recorded in the treatment T_{10}.

The N availability was found to be influenced significantly due to foliar application of Nano DAP. The observations are presented in Table 3. Significantly maximum N availability was observed in T_2 (100% recommended dose of NPK) which was 163.70 kg ha^{-1} over all other treatments might be due to application of 100% recommended dose of fertilizer followed by T_3 (155.70 kg ha^{-1}) and T6 (154.2 kg ha^{-1}). Similar results were found by Jana Harish *et al*. (2017).

Treatment T_1 (No N and P; 100% RD of K (Control) recorded lowest values of available N after harvest of Bt. Cotton (142.40 kg ha^{-1}) might be due to no application of fertilizer.

Availability of Phosphorous in Soil : The P availability was found to be influenced significantly due to foliar application of Nano DAP after harvest of Bt. cotton under drip irrigation. The observations are presented in Table 3. Significantly maximum P availability was observed in T_2 (100% recommended dose of NPK) which was 16.90 kg ha^{-1} over all other treatments. However it was at par with T_3, and T5. This might be due to foliar application of Nano DAP. Similar results were reported by Dhansil *et al*. (2018) using Nano phosphatic fertilizers increases nutritional content significantly. After harvest, the available nitrogen and phosphorous status in Nano fertilizers treated soil was higher than soil applied chemical fertilizers applied soil. This study clearly showed that using Nano fertilizer in pearl millet crops can save around 40% of the recommended phosphatic fertilizer dose.

Treatment T_1 i.e. No N and P; 100% RD of K (Control) recorded lowest values of available P after harvest of Bt. Cotton (10.70 kg ha^{-1}) might be due to no application of fertilizer.

Availability of potassium in soil : The K availability was found to be influenced

Table 3. Availability of NPK in soil at harvest as influenced by different treatment

Treatment	Total nutrient availability (kg ha^{-1})		
	N	P	K
DI with No N and P; 100% RD of K (Control)	142.4	10.70	464.2
DI 100% RDF of NPK	163.7	16.90	468.3
DI with 75% RDF of NPK	156.7	15.30	463.7
DI with 50% RDF of NPK	150.4	13.70	458.1
T_5 with T_3 + ST + Foliar spray of Nano DAP @ 2 ml lit^{-1} at 35 DAS	155.1	15.10	462.5
T_6 with T_3 + ST + Foliar spray of Nano DAP @ 4 ml lit^{-1} at 35 DAS	154.2	15.02	462.0
T_7 with T_4 + ST + Foliar spray of Nano DAP @ 2 ml lit^{-1} at 35 DAS	149.6	13.40	457.6
T_8 with T_4 + ST+Foliar spray of Nano DAP @ 2ml lit^{-1} at 35DAS	149.1	13.10	457.0
T_9 with T_4 + ST +Two foliar sprays of Nano DAP @ 2 ml lit^{-1} at 35 and 55 DAS	148.6	12.90	456.7
T_{10} with T_4 + ST +Two foliar sprays of Nano DAP @ 2 ml lit^{-1} at 35 and 55 DAS	147.5	12.50	456.0
S.E m ±	2.03	0.63	1.40
CD at 5%	6.10	1.88	4.20

significantly due to foliar application of Nano DAP after harvest of Bt. cotton under drip irrigation. The observations are presented in Table 3. Significantly maximum K availability was observed in T_2 (100 % recommended dose of NPK) which was 468.3 kg ha^{-1} over all other treatments however it was par with T_3 (463.70 kg ha^{-1}), T_5 (462.50 kg ha^{-1}) and T_6 (462.0 kg ha^{-1}). Treatment T_{10} (50% RDF + ST +Two foliar sprays of Nano DAP @ 4 ml lit^{-1} at 35 and 55 DAS) recorded minimum values of available K after harvest of Bt. Cotton (456.00 kg ha^{-1}) as compared to other treatments having 50% RDF might be due to higher K uptake. The similar results were reported Pawar *et al*. (2014) where 125% water soluble fertilizer applied through fertigation. The 75% drip fertigation as per scheduled B was found best practices to obtain better yield and improve nutrient status. The maximum K availability was observed in 125% fertigation with schedule B (483,491 and 486 kg ha^{-1}) and decreased with decreasing fertilizer levels.

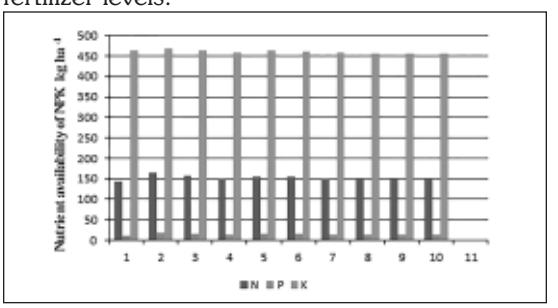

Fig. 2. Nutrient availability of NPK kg ha^{-1}

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Reviewer for Vol. 49(2) May 2024

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