Original Research Article

Effect of Various Levels of Phosphorus on Yield Attributing Characters,Yield and Nutrient Uptake by Cotton.

ABSTRACT

This study was carried out at Research Farm, Cotton Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the kharif season of 2021-2022 to evaluate the "Effect of various levels of phosphorus on yield and nutrient uptake by cotton in Vertisol". The trial used Randomized Block Design, with eight treatments reproduced three times. The prescribed fertilizer dose of 120:60:60 NPK kg ha^{-1} was administered according to the treatments. The cotton variety PDKV JKL116 was used in the current study. Similarly, Nano DAP was applied during seed treatment and foliar spray at 30 DAS, depending on the treatment. Cotton soil and plant samples were collected and analysed before and after harvesting using conventional procedures. The result revealed that, the application of 100% NPK resulted in the highest plant height, number of branches, number of bolls per plant, seed cotton, and stalk yield of cotton, followed by an application of N75 P75 K100+ Nano DAP (ST @ 5 ml/kg seed & FS @ 0.2% at 30 DAS). The application of 100% NPK resulted in the highest content and total absorption of N, P, K, and S, followed by the application of N75 P75 K100 + Nano DAP (ST @ 5 ml / kg seed & FS @ 0.2% at 30 DAS).

*Keywords- Phosphorus, Cotton, Vertisol, Nano DAP***.**

1. INTRODUCTION

Cotton (Gossypium hirsutum L.) is globally considered as one of the most important commercial crops. Being a cash crop, it is grown worldwide for the purpose of oil, lint, and feed for animals . About 30 million hectares of fertile land is engaged in cotton cultivation in almost 70 different countries of the world .India is the world's second largest cotton producer and consumer , with an average production of of 341.91(ICAC 2021)[6] lakh bales during 2021 . Due to its indeterminate growth habit, cotton exhibits morphological adaptation, such as modifying the canopy arrangement with phosphorus (P) application The primary factors in increasing seed cotton yield are morphological changes in terms of light capture,

sink to source relationships, and photo assimilates dispersion. Despite the introduction of new, high yielding cultivars, cotton production per unit area has been unaffected over the past 20 years. It is expected that using mineral fertilizers can increase cotton yield and improve nutrients in the soil.

Phosphorus (P) is the second most prevalent macronutrient in plants after nitrogen. P is scarce because of slow diffusion and quick fixing in soils. P can be a crucial limiting factor in plant growth. Mostly due to P fixation in the soil. It is the most studied element, yet it is also the least understood because of its convoluted chemistry in soilMost agricultural soils have more fixed P than accessible P, a lot of which has been built up from frequent P fertilizer applications .Soils' ability to deliver phosphorus to plants is known to vary greatly. The overall amount of P in soil that is available to plants is actually little. Numerous factors, including soil pH, texture, moisture, lime content, other nutrients, and more, affect its bioavailability in soil. In addition to these, another factor that makes phosphorus's permeability difficult is the fact that it can be found in soil in a variety different forms.. (Kothandaraman and Krishnamoorthy, 1979).[10]

2. MATERIALS AND METHODS

During 2021-22, a field experiment was carried out on the cotton research farm of Dr. PDKV, Akola. The experimental site has a subtropical climate with an average maximum high temperature of 37.8^{o}C and a minimum low temperature of 13.5^{o} C. The soil consisted of Vertisols from the smectite, hyperthermic family of Typic Haplusterts. The texture of the soil was clay, with a slightly alkaline pH (8.12), EC (0.22 d Sm^{-1}), organic carbon (4.72 g kg^{-1}), available N (174.86 kg ha^{-1}), P (12.84 kg ha^{-1}) and available K (378.14 kg ha^{-1}). The experiment involved eight different treatments. These treatments included a control group, different combinations of nutrients, and the application of a specific type of fertilizer. The experiment was conducted with three replications using a randomized block design. To conduct the experiment, the recommended amount of fertilizer was applied to the soil at the time of sowing, and an additional spray of a particular type of fertilizer was applied 30 days after sowing. The cotton variety "PDKV JKAL 116 Bt" was planted in July 2021, and the cotton was harvested in December 2021 and January 2022. After the cotton harvest, soil samples were collected from the top 15 centimeters of the plots and analyzed for various properties like pH, electrical conductivity, organic carbon, nitrogen, phosphorus, and potassium availability. The collected data were analyzed statistically using a specific procedure described by Gomez and Gomez (1984), and the significance of differences between treatment means was determined using a value called the least significant difference (LSD) at a significance level of 0.05.

3. RESULT AND DISCUSSION

3.1 Number of monopodial branches

At 60 days after sowing, the application of different phosphorus levels did not significantly affect the number of monpodial branches in cotton plants (Table 1). The highest number of monopodial branches (2.4) was observed when 100% NPK fertilizer was used. The application of N75 P75 K100 + Nano DAP fertilizer (ST @ 5 ml / kg seed & FS @ 0.2% at 30 DAS) also resulted in a relatively high number of main branches, while the absolute control group had the lowest number of monopodial branches (1.8) at 60 DAS.However, at 90 days after sowing, the different phosphorus levels had a significant effect on the number of monopodial branches. The highest number of monopodial branches (3) was observed with the application of 100% NPK fertilizer. This was similar to the number of momopodial branches (2.7) recorded when using N75 P75 K100 + Nano DAP fertilizer (ST @ 5 ml / kg seed & FS @ 0.2% at 30 DAS) and N50 P50 K100 + Nano DAP fertilizer (ST @ 5 ml / kg seed & FS @ 0.2% at 30 DAS). The absolute control group had the lowest number of monopodial branches.

3.2 Number of Sympodial branches.

The number of side branches in the cotton plants, known as sympodial branches, was significantly affected by the application of different levels of phosphorus at both 60 and 90 days after sowing (DAS) (Table 1). The highest number of sympodial branches (13.9 at 60 DAS and 28.5 at 90 DAS) was observed when 100% NPK fertilizer was used. This result was similar to the number of branches (13.1 at 60 DAS and 27.5 at 90 DAS) recorded when using N75 P75 K100+ Nano DAP fertilizer (ST @ 5 ml / kg seed & FS @ 0.2% at 30 DAS). On the other hand, the control group without any fertilizer application had the lowest number of sympodial branches at both 60 and 90 DAS. These findings align with similar results reported by Pati [13]) and Kakade [8].

3.3 Number of bolls per plant.

The highest number of cotton bolls per plant (36.2) was observed when applying 100% NPK fertilizer, according to Table 1. Conversely, the lowest number of cotton bolls was found in the absolute control group (11.8) with no fertilizer application. Applying N75 P75 K100 + Nano DAP fertilizer (ST @ 5 ml / kg seed & FS @ 0.2% at 30 DAS) resulted in a relatively high number of bolls (34.6), followed by treatment T7. These findings are consistent with the results reported by Patil [13*]* and Kakade [8].

Table 1 Effect various levels of phosphorus on growth attributes.

	Treatments	Monopodia		Sympodia		No of bolls/ plant
		60 DAS	90 DAS	60 DAS	90 DAS	
T1	N0P0K0	1.8	2.0	9.6	20.9	11.8
T2	N0P0K100	2.1	2.3	10.2	21.9	15.2
T3	N100 P100 K100	2.4	3.0	13.9	28.5	36.2
T4	N50 P50 K100	1.9	2.2	10.4	23.2	21.8
T5	N50 P50 K100 + Nano DAP (ST	2.1	2.5	12.9	24.7	26.8

	@ 2 .5 ml / kg seed & FS @ 0.2 %at 30 DAS)					
T6	N50 P50 K100+ Nano DAP (ST @ 5 ml / kg seed & FS @ 0.2 %at 30 DAS)	2.3	2.4	11.3	23.3	29.3
T7	N75 P75 K100+ Nano DAP (ST @ 2 .5 ml / kg seed & FS @ 0.2 %at 30 DAS)	2.1	2.6	12.6	25.9	33.4
T8	N75 P75 K100+ Nano DAP (ST @ 5 ml / kg seed & FS @ 0.2 %at 30 DAS)	2.3	2.7	13.1	27.5	34.6
	SE (M) ±	0.15	0.14	0.46	0.55	0.40
	CD at 5 %	NS	0.41	1.39	1.65	1.21

Yield:

The seed cotton and cotton stalk yield was ranged from 8.28 to 16.93 q ha^{-1}(table.2) and 12.43 to 29.62 q ha^{-1} respectively. The highest seed and stalk yield of cotton was recorded in the treatment T3 while the lowest yield was observed under the treatment T_1. The seed cotton and cotton stalk yield was 104.46 % and 138.29 % higher in treatment best as compare to control. The increased in the seed and stalk yield of cotton with the application of different levels of phosphorus was might be due to application of N and P nutrient to the crop at different rates which significantly increase its yield contributing characters which increases the yield. These results are analogous with the findings of Saleem [14], Khaswa [9]and Begum [1].

Table 2 Effect various levels of phosphorus on seed yield and stalk yield of cotton

Treatments		**Yield q ha^{-1}**	
		Seed	**Stalk**
T1	N0P0K0	8.28	12.43
T2	N0P0K100	9.86	15.18
T3	N100 P100 K100	16.93	29.62

T4	N50 P50 K100	13.95	23.16
T5	N50 P50 K100 + Nano DAP (ST @ 2 .5 ml / kg seed & FS @ 0.2 %at 30 DAS)	14.70	24.42
T6	N50 P50 K100+ Nano DAP (ST @ 5 ml / kg seed & FS @ 0.2 %at 30 DAS)	14.63	25.86
T7	N75 P75 K100+ Nano DAP (ST @ 2 .5 ml / kg seed & FS @ 0.2 %at 30 DAS)	14.80	26.02
T8	N75 P75 K100+ Nano DAP (ST @ 5 ml / kg seed & FS @ 0.2 %at 30 DAS)	15.05	26.60
	SE (M) ±	0.60	0.96
	CD at 5 %	1.80	2.89

3.2 Uptake: -

3.2.1 Nitrogen uptake

The application of 100% NPK fertilizer resulted in the highest uptake of nitrogen by the cotton seeds, as shown in Table 3. On the other hand, the absolute control group had the lowest seed nitrogen uptake. The treatment with the best results showed a 119.31% higher seed nitrogen uptake compared to the absolute control.Similarly, the application of 100% NPK fertilizer led to the significantly highest uptake of nitrogen by the cotton stalks, while the absolute control group had the lowest seed nitrogen uptake. The treatment with the best results showed a 363.89% higher stalk nitrogen uptake compared to the absolute control.Moreover, the total nitrogen uptake by cotton was significantly highest (83.29 kg ha^{-1}) with the application of 100% NPK fertilizer, while the absolute control had the lowest total nitrogen uptake (29.39 kg ha^{-1}). The application of 100% NPK fertilizer had a 183.40% higher uptake compared to the absolute control. These increases in nitrogen uptake in cotton can be attributed to the higher nitrogen doses in different treatments, which ultimately increased the yield and uptake. Similar results have been reported by Gadhia [3] and Sharma [14].

3.2.2 Phosphorus uptake

The highest uptake of phosphorus by cotton seeds (7.29 kg ha^{-1}) was observed with the application of 100% NPK fertilizer, as shown in Table 3. Conversely, the absolute control group had the lowest seed phosphorus uptake. The application of 100% NPK fertilizer resulted in a 355.62% higher seed phosphorus uptake compared to the absolute control.Similarly, the significantly highest uptake of phosphorus by cotton stalks (9.18 kg ha^{-1}) was recorded with the application of 100% NPK fertilizer, while the absolute control had the lowest stalk phosphorus uptake (3.12 kg ha^{-1}). The treatment with the best results showed a 363.89% higher stalk phosphorus uptake compared to the absolute

control.Furthermore, the application of 100% NPK fertilizer resulted in the significantly highest total phosphorus uptake by cotton (16.47 kg ha^{-1}), while the absolute control had the lowest total phosphorus uptake (4.72 kg ha^{-1}). The total phosphorus uptake was 249% higher in the treatment with the best results compared to the absolute control. These significant increases in phosphorus uptake by cotton may be attributed to the higher doses of phosphorus in the different treatments, which ultimately increased the yield and uptake. Similar results have been reported by Saleem [14], Sharma [15], and Tembhurne [17].

3.2.3 Potassium uptake

The application of 100% NPK fertilizer resulted in the highest uptake of potassium by cotton seeds, as shown in Table 4. The absolute control group had the lowest seed potassium uptake. The application of 100% NPK fertilizer led to a 161% higher seed potassium uptake compared to the absolute control.

Similarly, the significantly highest uptake of potassium by cotton stalks was recorded with the application of 100% NPK fertilizer, while the absolute control had the lowest stalk potassium uptake. The treatment with the best results showed a 224.75% higher stalk potassium uptake compared to the absolute control.

Table 3: Effect various levels of phosphorus on N and p uptake of nutrient by cotton.

Treatments		N uptake kg ha^{-1}			P uptake kg ha^{-1}		
		seed	stalk	total	seed	stalk	total
T1	N0P0K0	21.69	7.70	29.39	1.60	3.12	4.72
T2	N0P0K100	26.13	13.35	39.48	2.08	3.49	5.57
T3	N100 P100 K100	47.57	35.72	83.29	7.29	9.18	16.47
T4	N50 P50 K100	37.94	25.47	63.41	4.50	6.17	10.67
T5	N50 P50 K100 + Nano DAP (ST @ 2 .5 ml / kg seed & FS @ 0.2 %at 30 DAS)	40.72	27.35	68.07	5.33	6.32	11.65
T6	N50 P50 K100+ Nano DAP (ST @ 5 ml / kg seed & FS @ 0.2 %at 30 DAS)	43.45	30.08	73.53	5.92	6.79	12.71
T7	N75 P75 K100+ Nano DAP (ST @ 2 .5 ml / kg seed & FS @ 0.2 %at 30	43.40	32.15	75.57	5.98	7.14	13.12

	DAS)						
T8	N75 P75 K100+ Nano DAP (ST @ 5 ml / kg seed & FS @ 0.2 %at 30 DAS)	44.42	32.67	77.09	6.04	7.37	13.18
	SE (M) ±	0.88	0.93	1.29	0.38	0.64	1.06
	CD at 5 %	2.64	2.81	5.89	1.16	1.92	3.17

Furthermore, the application of 100% NPK fertilizer resulted in the significantly highest total potassium uptake by cotton, while the absolute control had the lowest total potassium uptake. The total potassium uptake was 206.37% higher compared to the absolute control. These significant increases in potassium uptake by cotton may be attributed to the higher doses of potassium in the different treatments, which ultimately increased the yield and uptake. Similar results have been reported by Gadhia [3] and Saleem [14].

3.2.4 Sulphur uptake

The highest uptake of sulphur by cotton seeds (5.90 kg ha^{-1}) was observed with the application of 100% NPK fertilizer, as shown in Table 4. On the other hand, the absolute control group had the lowest seed sulphur uptake (2.70 kg ha^{-1}). The application of 100% NPK fertilizer resulted in a 320% higher seed sulphur uptake compared to the absolute control.Similarly, the significantly highest uptake of sulphur by cotton stalks (4.45 kg ha^{-1}) was recorded with the application of 100% NPK fertilizer, while the absolute control had the lowest stalk sulphur uptake (1.72 kg ha^{-1}). The treatment with the best results showed a 273% higher stalk sulphur uptake compared to the absolute control.

Table 4: Effect various levels of phosphorus on K and S uptake of nutrient by cotton.

	Treatments	**K uptake kg ha^{-1}**			**S uptake kg ha^{-1}**		
		Seed	**Stalk**	**Total**	**seed**	**stalk**	**Total**
T1	N0P0K0	4.03	9.94	13.97	2.70	1.72	4.43
T2	N0P0K100	6.06	15.78	21.84	3.34	2.16	5.49
T3	N100 P100 K100	10.52	32.28	42.80	5.90	4.45	10.35
T4	N50 P50 K100	8.71	24.54	33.25	4.75	3.36	8.11
T5	N50 P50 K100 + Nano DAP (ST @ 2 .5 ml / kg seed & FS @ 0.2 %at 30 DAS)	8.17	26.12	35.29	5.02	3.71	8.73
T6	N50 P50 K100+ Nano DAP (ST @ 5 ml / kg seed & FS @ 0.2 %at 30 DAS)	8.59	28.27	36.86	5.25	4.16	9.41
T7	N75 P75 K100+ Nano	8.96	28.18	37.14	5.39	3.97	9.37

	DAP (ST @ 2 .5 ml / kg seed & FS @ 0.2 %at 30 DAS)						
T8	N75 P75 K100+ Nano DAP (ST @ 5 ml / kg seed & FS @ 0.2 %at 30 DAS)	9.16	28.81	37.97	5.45	4.24	9.69
	SE (M) ±	0.40	1.08	1.40	0.45	0.32	0.76
	CD at 5 %	1.21	3.24	4.22	1.35	0.96	2.29

Furthermore, the application of 100% NPK fertilizer resulted in the significantly highest total sulphur uptake by cotton (10.35 kg ha^{-1}), while the absolute control had the lowest total sulphur uptake (4.43 kg ha-1). The total sulphuruptake was 133.63% higher compared to the absolute control. These significant increases in sulfur uptake by cotton may be attributed to the higher doses of sulphur in the different treatments, which ultimately increased the yield and uptake. Similar results have been reported by Bharambe and Tomar [2] and Sharma [*15*].

CONCLUSION

It can be concluded from the present investigation that, , the application of 100 % recommended NPK dose were improved the higher seed and stalk yield of cotton and nutrient uptake by cotton.

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