



## Full Length Research Article

# INFLUENCE OF FERTILIZER LEVELS AND ORGANIC NITRIFICATION INHIBITORS ON YIELD, UPTAKE OF NUTRIENTS IN COTTON

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Accepted 16<sup>th</sup> January 2016; Published Online February 29<sup>th</sup> 2016

### ABSTRACT

A field experiment was conducted during kharif season of 2013<sup>-14</sup> at department of Agronomy farm, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, to study the productivity and nitrogen use efficiency in cotton using organic nitrification inhibitors. The experiment was laid out in factorial randomized block design with three replications each having nine treatment combinations comprising three fertilizer levels viz., 75% RDF (F1), 100% RDF (F2) and 125% RDF (F3) and three nitrification inhibitors viz., neem cake @ 300 kg ha<sup>-1</sup> (N1), karanj cake @ 300 kg ha<sup>-1</sup> (N2) and control (N3). The result showed that various all growth attributes were higher in F3 over F1 and which at par with F2. In case of yield attributes and yield were significantly higher in F3 over F2 and F1. Uptake of NPK kg ha<sup>-1</sup> after harvest of cotton crop was significantly higher in F3 over F2 and F1. Significantly highest nitrogen use efficiency was recorded with fertilizer level F1 as compared to F2 and lowest nitrogen use efficiency was recorded with F3. Amongst nitrification inhibitors, N2 increases potentiality of growth characters, yield attributes, uptake of NPK and NUE as compared to control and at par with N1. Interaction effect between fertilizer level and nitrification inhibitors were found to be non significant at all growth attributes and uptake of nutrient but was significant in respect of seed cotton yield.

**Key words:** Cotton, Fertilizer level, Nitrification inhibitor and Nitrogen use efficiency.

### INTRODUCTION

Cotton (*Gossypium hirsutum L.*) one of the major cash crop of India, is popularly known as White Gold for its role in national economy in terms of foreign exchange earnings and employment generation. In India 116.14 lakh hectares area is under cotton crop with production of 334 lakh bales and productivity of 489 kg per hectares is grown on throughout the country (Anonymous, 2013). Cotton is a long duration crop with an indeterminate growth habit. In India cotton crop mainly grown in kharif season and applied 60:30:30 NPK kg ha<sup>-1</sup> (RDF), but cotton demands higher doses of nitrogen for rapid growth, increases leaf size and quality, hastens crop maturity, and promotes fruit and seed development. Nitrogen plays an important role in almost all plant metabolic processes and also needed for the synthesis of chlorophyll which is required for photosynthesis. New leaves may contain up to 6% N. It is a very mobile nutrient and moves from older to newer leaves as the plant ages. Nitrogen is taken up throughout the growing season and it is transported and stored in the leaves. The N requirements for boll development are partially met from N stored in the leaf canopy. The deficiency of nitrogen results in poor growth and yield. Nitrogen is one of the factors that directly influence vegetative growth and dry matter production.

For improving productivity of cotton the integrated nutrient management practices are adapted, like use of organic and inorganic fertilizers, nitrification inhibitors and soil management practices for enhancing the nitrogen use efficiency of crop. The nitrogen use efficiency of cotton is only about 20-30%. Nitrogen may be lost through various ways like, denitrification, leaching, volatilization and fixation. Nitrification inhibitors reduces the loss of nitrogen and its slow down the conversion rate of ammonium nitrogen to nitrate nitrogen and therefore the ammonium nitrogen forms are available to plants for longer time period. This increases the growth of crop and also improves soil fertility. Nitrification inhibitors are eco-friendly and easily available. It helps in increasing the nitrogen use efficiency that will help for better growth and development of crop. Being totally natural, it is eco-friendly and thus it nourishes soil and plant by providing macro and micro nutrients, these cakes reduces the alkalinity in soil, as it produces organic acids on decomposition (Solomon *et al.*, 2013). Considering the importance of organic nitrification inhibitors like neem cake and karanj cake in cultivation of cotton the present study was planned for assessment of productivity and nitrogen use efficiency in cotton using different fertilizer doses and organic nitrification inhibitors.

### MATERIALS AND METHODS

A field experiment was carried out during *kharif* season of 2013<sup>-14</sup> at department of Agronomy farm, Dr. Panjabrao

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Deshmukh Krishi Vidyapeeth, Akola. The experiment was laid out in factorial randomized block design with three replications each having nine treatment combinations comprising three fertilizer levels viz., 75% RDF (F<sub>1</sub>), 100% RDF (F<sub>2</sub>) and 125% RDF (F<sub>3</sub>) and nitrification inhibitors viz., neem cake @ 300 kg ha<sup>-1</sup> (N<sub>1</sub>), karanj cake @ 300 kg ha<sup>-1</sup> (N<sub>2</sub>) and control (N<sub>3</sub>). The cotton hybrid PKVH-2 was sown on 27 June at 90 x 45 cm spacing. The soil of experimental plot was clayey in texture, slightly alkaline in nature (pH 7.8) having moderate organic carbon content, low available nitrogen, low available phosphorus and high available potassium. The fertilizers given on the basis of treatment i.e. 75% (45:22.5:22.5 NPK kg ha<sup>-1</sup>), 100% (60:30:30 NPK kg ha<sup>-1</sup>) and 125% (75:37.5:37.5 NPK kg ha<sup>-1</sup>). Application of 1/3 dose of nitrogen and full dose of phosphorus and potassium at a time of sowing, 1/3 dose of nitrogen 30DAS and remaining 1/3 dose of nitrogen applied at 60 DAS.

The crop was fertilized with nitrogen, phosphorus and potassium through urea, SSP and MOP, respectively. Before three days of sowing neem cake and karanj cake was applied in field and mixed thoroughly with the help of harrow. Neem cake and karanj cake contain 5:1:2% and 4:0.9:1.3% NPK, respectively. Besides role as nitrification inhibitor neem cake and karanj cake add approximately 15:3:6 and 12:2.7:3.9 kg NPK ha<sup>-1</sup>. Total rainfall of 691.2 mm was recorded during the crop growing season. The cotton crop was shown on June 27 (26<sup>th</sup> meteorological week) and last picking was under taken on December 28 (52<sup>nd</sup> meteorological week). Due to continuous rainy days from 16 July to 26 August the crop suffer from water logging condition but later during the month of November and December due to favourable weather conditions and better moisture availability in soil which favours the conversion of fruiting bodies in to fully developed bolls.

## RESULTS AND DISCUSSION

### Effect of fertilizer levels on growth attributes of cotton

The growth attributes were significantly influenced by fertilizer levels. The data revealed that the application of 125% RDF recorded maximum plant height, number of functional leaves plant<sup>-1</sup>, monopodial and sympodial branches and leaf area plant<sup>-1</sup>(dm<sup>2</sup>) as compared to application of 75% RDF but on par with 100% RDF. The Application of higher dose of fertilizer might have increased the nutrient availability which in turn results in increased vital physiological process and enhance cell division and cell elongation process and resultant increase in height, monopodial and sympodial branches and hence, increased the number of leaves and leaf area per plant. Similar results were also reported by Khawale *et al.*, (2001) and Rao and Janwade (2006). In case of dry matter accumulation plant<sup>-1</sup>(gm) application of 125% RDF was significantly superior than 100% and 75% RDF. Increased rate of application of nutrients recorded increased leaf photosynthetic rate which might have resulted in higher accumulation of metabolites in both vegetative and reproductive fractions thus recorded significant gain in total dry matter per plant, these results are similar with the findings of Hosamani *et al.*, (2013).

### Effect of nitrification inhibitors on growth attributes of cotton

Application of karanj cake @ 300 kg ha<sup>-1</sup> recorded maximum plant height, number of leaves, leaf area and dry matter accumulation plant<sup>-1</sup> (gm), monopodial and sympodial branches as compare to control and were at par with application of neem cake @ 300 kg ha<sup>-1</sup>(Table 1). Nitrification inhibitors has property to slower down the process of conversion ammonium N to nitrate N and making nitrogen available throughout crop growth which might have resulted in enhanced cell division and increased growth attributing characters of plant. Similar results were recorded by Sarkar *et al.*, (2011) on potato, Murugan *et al.*, (2011).

### Effect of fertilizer levels on yield attributes and yields of cotton

The maximum number of bolls plant<sup>-1</sup>, Seed cotton yield and stalk yield kg ha<sup>-1</sup> were recorded with fertilizer level 125% RDF, which was significantly superior than 75% RDF and 100% RDF level. Significant improvement in boll weight with increasing fertilizer level might be due to the active role of N in the growth and development of cotton plant. Sufficient amount of N when applied is utilized by the plants in photosynthesis process and the resultant photosynthates are diverted to different parts of the plant where they are needed as sink it results into proliferation of bolls, as the number of bolls per plant increases simultaneously yield per plant increases. Similar results were also recorded by Bhalerao *et al.*, (2007) and Hosamani *et al.*, (2013).

### Effect of nitrification inhibitors on yield attributes and yields of cotton

Highest number of bolls plant<sup>-1</sup>, Seed cotton yield and stalk yield kg ha<sup>-1</sup> were recorded with application of karanj cake @ 300 kg ha<sup>-1</sup> which was significantly superior than control and neem cake @ 300 kg ha<sup>-1</sup>. The favourable effect of nitrification inhibitors is to reduce losses of N by inhibiting the activities of nitrifying bacteria and slow release of N over a prolonged period, which might have increased uptake of nitrogen resulting in increased number of bolls per plant, weight of boll and seed cotton yield per plant resulting increased seed cotton yield. These results was supported with findings of Osman *et al.*, (2009).

### Effect of fertilizer levels on uptake of nutrient

Varied fertilizer levels significantly influence on total nitrogen, phosphorus and potassium uptake, significantly higher level of NPK uptake recorded with fertilizer level 125% RDF, which was significantly superior than 100% RDF and 75% RDF. The highest nitrogen use efficiency (19.59 kg kg<sup>-1</sup>) was recorded with fertilizer level 75% RDF and lowest NUE (12.88 kg kg<sup>-1</sup>) was recorded with 125% RDF, the 100% RDF was recorded NUE 15.89 kg kg<sup>-1</sup>. Under higher level of fertilizer plant extract more nutrients from soil as compared to low level of fertilizer. Total nutrient uptake with increase in fertilizer level might be related to increase in dry matter accumulation and their respective content in plant with increase in fertilizer levels. These results are supported with the finding by Gundlur *et al.*, (2013).

Table 1. Influence of different treatments on growth attributes of cotton

Treatment	Height (cm)	No. of functional Leaves plant <sup>-1</sup>	Monopodial braches plant <sup>-1</sup>	Sympodial branches plant <sup>-1</sup>	Leaf area plant <sup>-1</sup> (dm <sup>2</sup> )	Dry matter plant <sup>-1</sup> (g)
A. Fertilizer level						
F <sub>1</sub> -75% RDF	88.36	78.28	2.42	19.10	45.50	76.03
F <sub>2</sub> -100% RDF	92.71	84.96	2.60	20.43	47.08	77.37
F <sub>3</sub> -125% RDF	94.12	85.66	2.62	21.23	48.71	79.64
SE(m)±	0.98	1.23	0.04	0.32	0.80	0.25
CD at 5%	2.94	3.69	0.11	0.97	2.41	0.74
B. Nitrification inhibitors						
N <sub>1</sub> -Neem cake @ 300 kg ha <sup>-1</sup>	93.32	85.29	2.60	20.54	47.93	79.16
N <sub>2</sub> -Karanj cake @ 300 kg ha <sup>-1</sup>	93.90	86.06	2.62	20.81	49.18	79.52
N <sub>3</sub> -Control	87.98	77.54	2.42	19.41	44.18	74.36
SE(m)±	0.98	1.23	0.04	0.32	0.80	0.25
CD at 5%	2.94	3.69	0.11	0.97	2.41	0.74
C. Interaction A x B						
SE(m)±	1.70	2.13	0.06	0.56	1.39	0.43
CD at 5%	NS	NS	NS	NS	NS	NS

Table 2. Influence of different treatment on yield attributes and nitrogen use efficiency

Treatment	No. of bolls picked plant <sup>-1</sup>	Seed cotton yield (kg ha <sup>-1</sup> )	Stalk yield (kg ha <sup>-1</sup> )	Uptake (kg ha <sup>-1</sup> )			NUE (kg kg <sup>-1</sup> )
				N	P	K	
A. Fertilizer level							
F <sub>1</sub> -75% RDF	18.69	876	1482	28.41	11.5	31.56	19.59
F <sub>2</sub> -100% RDF	19.52	940	1568	32.15	12.48	33.55	15.89
F <sub>3</sub> -125% RDF	22.47	960	1653	33.59	14.16	34.65	12.88
SE(m)±	0.21	12.28	19.29	0.35	0.19	0.18	0.21
CD at 5%	0.63	36.83	57.84	1.05	0.57	0.54	0.62
B. Nitrification inhibitors							
N <sub>1</sub> -Neem cake @ 300 kg ha <sup>-1</sup>	20.54	948	1570	32.59	12.90	34.12	16.38
N <sub>2</sub> -Karanj cake @ 300 kg ha <sup>-1</sup>	21.35	965	1606	33.40	13.58	34.49	16.74
N <sub>3</sub> -Control	18.78	864	1527	28.16	11.65	31.13	15.24
SE(m)±	0.21	12.28	19.29	0.35	0.19	0.18	0.21
CD at 5%	0.63	36.83	57.84	1.05	0.57	0.54	0.62
C. Interaction A x B							
SE(m)±	0.36	21.28	33.42	0.68	0.33	0.31	0.36
CD at 5%	NS	63.79	NS	NS	NS	NS	NS

Table 3. Seed cotton yield (kg ha<sup>-1</sup>) influenced by fertilizer levels and nitrification inhibitors

Interaction A x B	N <sub>1</sub>	N <sub>2</sub>	N <sub>3</sub>	Mean
F <sub>1</sub>	907	868	853	876
F <sub>2</sub>	940	1002	879	940
F <sub>3</sub>	995	1026	859	960
Mean	948	965	864	926
SE(m)±		21.27		
CD at 5%		63.79		

### Effect of nitrification inhibitors on uptake of nutrient

Application of nitrification inhibitors significantly influenced the NPK uptake and NUE by cotton, highest NPK uptake and NUE was recorded with karanj cake application @ 300 kg ha<sup>-1</sup> which was significantly superior than control and comparable with neem cake application @ 300 kg ha<sup>-1</sup>. Control release of nutrients due to nitrification inhibitors increased the resultant availability of nitrogen during whole crop season might have enhanced the uptake of nitrogen which increases yield attributes, similar results were recorded by Sarkar *et al.*, (2007), and Osman *et al.*, (2009).

### Interaction between fertilizer levels and nitrification inhibitors in seed cotton yield

Interaction between fertilizer levels and nitrification inhibitors in seed cotton yield was found to be significant. The highest seed cotton yield was recorded with combination of 125% RDF and karanj cake application @ 300 kg ha<sup>-1</sup>, which was at

par with combination of 125% RDF and neem cake application and combination of 100% RDF and karanj cake @ 300 kg ha<sup>-1</sup> as increase in fertilizer level helps to improve growth and yield contributing characters of plants and karanj cake has property to reduce losses of nitrogen by increasing time of conversion of nitrogen thus in soil higher level of ammonical form of nitrogen for longer time than nitrate. Thus reduces losses from the soil, favouring more utilization of nutrients by plant and enhanced the translocation of photosynthates towards sink and increase seed cotton yield. This result was supported with findings of Sarkar *et al.*, (2007).

### Interaction effect of fertilizer level and nitrification inhibitor on growth, yield and uptake of nutrient

Interaction effect between fertilizer level and nitrification inhibitors were found to be non significant at all growth attributes and uptake of nutrient but was significant in respect of seed cotton yield.

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