

**STUDIES ON EFFICACY OF COATED FERTILIZER ON  
SOIL PROPERTIES, YIELD AND QUALITY OF  
Bt COTTON**

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**B.Sc. (Agriculture)**

**MASTER OF SCIENCE  
IN  
AGRICULTURE  
(SOIL SCIENCE AND AGRICULTURAL CHEMISTRY)**



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PARBHANI – 431 402 (M.S.) INDIA**

**2022**

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SOIL PROPERTIES, YIELD AND QUALITY OF  
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**BY  
BELDAR RUSHIKESH RAMCHANDRA**

**B.Sc. (Agriculture)**

**A thesis submitted to  
Vasantnao Naik Marathwada Krishi Vidyapeeth, Parbhani  
in partial fulfillment of the requirement for the degree of**

**MASTER OF SCIENCE  
IN  
AGRICULTURE  
(SOIL SCIENCE AND AGRICULTURAL CHEMISTRY)**



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COLLEGE OF AGRICULTURE, PARBHANI  
VASANTRAO NAIK MARATHWADA KRISHI VIDYAPEETH  
PARBHANI – 431 402 (M.S.) INDIA**

**2022**

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I hereby declare that the thesis entitled, “STUDIES ON EFFICACY OF COATED FERTILIZER ON SOIL PROPERTIES, YIELD AND QUALITY OF Bt COTTON”, submitted by me is based on the actual work carried out by me under the guidance and supervision of **Waikar Suresh Laxmanrao**. The extent of information derived from the existing literature have been duly cited and referenced. The existing research work or its any part is not submitted anywhere else for the award of any degree or diploma.

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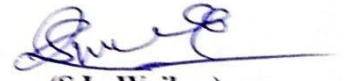
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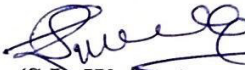
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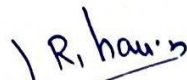
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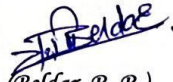
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## ABBREVIATIONS AND SYMBOLS

%	- Per cent
/	- Per
@	- At the rate of
°C	- Degree centigrade
AAS	- Atomic Absorption Spectrophotometer
AE	- Agronomic Efficiency
ANR	- Apparent Nutrient Recovery
Ca	- Calcium
CD	- Critical difference
CEC	- Cation Exchange Capacity
Cm	- Centimeter
CRF	- Control Release Fertilizer
Cu	- Copper
DAP	- Diammonium Phosphate
DAS	Days after sowing
dSm <sup>-1</sup>	- Deci Siemens per meter
DTPA	- Diethylene Triamine Penta Acetic Acid
EC	- Electrical Conductivity
EDTA	- Ethylene Di-amine Tetra Acetic Acid
<i>et al.</i>	- et alia and other
etc.	- Etcetera
Fe	- Iron
Fig.	- Figure
g ha <sup>-1</sup>	- Gram per hectare
i.e.	- that is
K	- Potassium
Kg	- Kilogram
kg ha <sup>-1</sup>	- Kilogram per hectare
Max	- Maximum
Mg	- Milligram

Mg	- Magnesium
mg kg <sup>-1</sup>	- Milligram per kilogram
Min	- Minimum
Mm	- Millimetre
MN	- Micronutrient
Mn	- Manganese
Mt	Metric ton
MOP	- Muriate of potash
N	- Nitrogen
No.	- Number
NS	- Non- significant
NUE	- Nutrient Use Efficiency
OC	- Organic carbon
P	- Phosphorus
PFPP	- Partial Factor Productivity
Ppm	- Parts per million
RDF	- Recommended Dose of Fertilizer
S	- Sulphur
SD	- Standard Deviation
SE ( $\pm$ m)	- Standard Error mean
SE $\pm$	- Standard Error
Sec	- Secondary Micronutrient
Sig.	- Significant
SSP	- Single Super Phosphate
SRF	- Slow-Release Fertilizer
Viz.	- Namely
Zn	- Zinc

# **THESIS ABSTRACT**

## THESIS ABSTRACT

---

<b>Title of the thesis</b>	: “Studies on efficacy of coated fertilizer on soil properties, yield and quality of bt cotton”
<b>Name of the student</b>	: Beldar Rushikesh Ramchandra
<b>Full Name of Research Guide</b>	: Waikar Suresh Laxmanrao
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<b>College/ University</b>	: Vasantao Naik Marathwada Krishi Vidyapeeth, Parbhani
<b>Degree to be awarded</b>	: M. Sc. (Agri.) in Soil Science

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### ABSTRACT

A field experiment was conducted during *Kharif* season 2020-21 at Research Farm, Department of soil science and Agricultural chemistry, Vasantao Naik Marathwada Krishi Vidyapeeth, Parbhani on “Studies on efficacy of coated fertilizer on soil properties, yield and quality of bt cotton”. The experiment was laid out in randomized block design with nine treatment and three replications. The results indicated that growth parameter like plant height, number of monopodial branches, number of sympodial branches, days to 50 % flowering, soil plant analysis development values showed significantly maximum with (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) at respective growth stages. Significantly higher number of bolls plant<sup>-1</sup>, mean boll weight, dry matter yield, seed cotton yield was recorded in the treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2). The results shows that quality parameter like ginning percentage, seed index, lint index, staple length were maximum in treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2). The effect of coated fertilizer on soil pH, EC, Organic carbon content was found non-significant at harvest of bt cotton. There was increase in calcium carbonate content in all the treatment over the initial values. The nitrogen, phosphorus, potassium, sulphur and DTPA extractable micronutrient (Fe, Mn, Zn, Cu) availability found maximum in treatment (T<sub>3</sub>),

receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2).

The highest N, P, K and S concentration in seed and straw of bt cotton was recorded in treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2), whereas lowest concentration in seed and straw noted in treatment (T<sub>1</sub>) *i.e.*, absolute control. The Fe, Mn, Zn and Cu concentration in seed and straw of bt cotton were found maximum with the treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) and minimum values of Fe, Mn, Zn and Cu concentration in seed and straw of bt cotton were noted in farmer practice. The nutrient uptake of bt cotton was significantly enhanced with application of coated fertilizer grade. Application of fertilizers through coated fertilizer grade than non-coated fertilizer grade showed highest value of N, P, K, S, Fe, Mn, Zn and Cu uptake in seed, straw and total uptake. Whereas lowest value was recorded in farmer practice. The highest nutrient use efficiency was recorded in treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2).

Thus application of fertilizer through 100 % RDF through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) has found better for yield and quality parameters of Bt cotton.

---

**(Key words:** Bt cotton, coated fertilizer grade, yield, nutrient uptake, nutrient use efficiency)

**CHAPTER -I**  
**INTRODUCTION**

## CHAPTER - I

### INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is one of the most important commercial cash crop and important fiber crop of global significance cultivated in more than seventy countries. It is an important raw material of economy in terms of both employment generation, foreign exchange and hence it is popularly known as “White gold or friendly fiber”. The cotton plant belongs to the genus *Gossypium* of the family *Malvaceae*. It is grown for fiber and seed. Cotton is a multipurpose crop that supplies five basic products such as lint, oil, meal, seed and hulls and is popularly known as “King of Fiber”. Cotton is one of the principal crops of India and plays a vital role in the country’s economic growth by providing substantial employment and making significant contributions to export earnings. It plays a key role in economic and social affairs. This need to increase both the national and food supply is perhaps one of the biggest challenges that ever been seen. Agricultural scientists believe that this challenge can be met by developing high yielding new varieties, effectively controlling pests and applying appropriate agronomic practices.

India rank first in area and second in production of cotton after China. In India, cotton is grown in ten states, out of which nine states grow both bt as well as non-bt cotton and Odisha is the state which grows only non-bt cotton. Maharashtra, Gujarat and Telangana occupy 70% of the total cotton area in India and 60% of overall cotton production in the country. These three states cultivate cotton in different agroclimatic conditions. Maharashtra state is the largest area and production under cotton cultivation in the country, but per hectare productivity is far below as compare to cotton growing states.

In Maharashtra, cotton is the major crop cultivated in large extent besides soybean, maize, rice, wheat, pulses and other oilseeds. In general, Bt cotton hybrids are suitable for irrigated condition and it has been proved from production and productivity levels of Gujarat, Punjab and Haryana. In Maharashtra, cotton is cultivated primarily under rainfed condition that led to low productivity. In India, total area occupied by cotton during 2018-19, was 126.58 lakh hectares with production of 333.00 lakh bales and yield was 448.79 kg ha<sup>-1</sup>. However, during 2017-18, cotton occupied 125.90 lakh hectares with a production of 328.1 lakh bales and yield was

443 kg ha<sup>-1</sup>. In India, Maharashtra is important cotton growing states occupying cotton acreage of about 43.50 and 42.50 lakh hectares with average lint yield of 238 and 285 kg ha<sup>-1</sup> during 2017-18 and 2018-19, respectively. While, production of cotton was 60.09 and 71.30 lakh bales in 2017-18 and 2018-19 (Anonymous, 2019).

The genetically modified Bt cotton, containing the cry gene confer resistance to bollworms was first adopted as hybrid in 2002 in India. India, the largest cotton grower in the world has benefitted of spectacular success with Bt cotton for the past twenty years. Bt cotton contributed to increased productivity and reduced requirements for pesticides while, contributing to better and most sustainable environment in the face of climate change (Sudha *et al.*, 2014).

Nitrogen is one of the essential primary nutrients required for all crops in sufficiently large amount. Nitrogen is lost through soil system through different mechanisms such as runoff, leaching, denitrification, NH<sub>3</sub> volatilization loss from crop canopy. Urea is most popular and major nitrogenous fertilizer in India because of its easy transportability, solid form and high N content. The recovery of applied urea fertilizer in India in summer season crops is 30-50 per cent (Prasad *et al.*, 2000). When urea is applied in the field, it is hydrolyzed by urease enzyme to ammonia (NH<sub>4</sub>) and then further converted to nitrates (NO<sub>3</sub><sup>-</sup>) which are susceptible to volatilization, denitrification and leaching losses, respectively. The arrest of nitrogen loss can help to increase nitrogen utilization per unit area. It will help in lowering the cost of cultivation and increase in benefit to farmers and minimizing nitrate pollution. Recently several techniques have been evolved to coat the fertilizer material, which will help to reduce the losses and ensure their sustained release. Later on many slow release urea fertilizers like sulphur coated urea (SCU), neem oil coated urea (NOCU), isobutylidenediurea (IBDU) and lac coated urea (LCU) etc. have been developed. If urea fertilizers are modified with indigenously available material like neemcake, then they are economical to the farmers for farm use (Bharathi and Sekar, 2016). The coating of urea with neem formulations not only increases the NUE, apparent N recovery and grain yield but also helps in reducing the environmental ill effects related to use of large amount of urea fertilizer (Singh and Shivay, 2003). An indigenous technology for increasing the efficiency of urea is treating it with acetone extract of neem kernel (Bains *et al.*, 1971). The improvement in fertilizer use efficiency of chemical fertilizers by using nitrification inhibitors may play a key role

in minimizing environmental damage and increasing productivity (Chen *et al.*, 2008). It is showed that, dicyandiamide (DCD) can significantly decrease N<sub>2</sub>O emissions and NO<sub>3</sub> leaching from cropping systems (Cui *et al.*, 2011), which is a most common nitrification inhibitor with no traces of residue left and that is naturally broken down in the soil (Singh and Verma, 2007). Thus, loss of nitrogen due to fixation, volatilization and the activated risk of nitrate leaching after fertilizer application to the crop may be minimized by using slow-release fertilizers (Jagadeeswaran *et al.*, 2005). The slow-release N fertilizers are grouped in different types of coated conventional fertilizers such as sulphur coated urea, polymer coated urea, neem coated urea and the inherently less soluble materials *viz*; Crotonylidene diurea (CDU), Isobutylidene diurea (IBDU) and Ureaform (ureaformaldehyde). Like nitrogen, phosphorus is metabolically active compound and structural component of plant cell wall. It has vital role in metabolic processes of the plants and energy transformations. The effectiveness of mineral phosphorus fertilizers is typically questioned when used in soils with high calcium carbonate levels because P is quickly fixed into sparsely soluble forms that are challenging for plants to absorb (Chien *et al.*, 2011). Lower tillering/branching, decreased plant height, reduced dry matter output, and decreased seed production are all effects of P deficiency.

As calcium and magnesium phosphates precipitate over time, it is thought that the phosphatic fertilizers provided will become less available in the soil over time (Messier, 1990) and these reaction products reduce the P availability to plants (Barrow, 1980). This is a severe problem, which affects semiarid and arid agricultural soils and it is difficult to overcome this problem since the response to phosphatic fertilizers is limited (Chand and Tomar, 1993). By restricting the amount of applied P that comes into contact with the soil, slow release or coated P fertilizers can increase the P availability by decreasing the likelihood of precipitation and adsorption on soil colloids. The benefit of coordinating fertilizer P release with plant requirements may boost crop output and applied P recovery (Dahnke *et al.*, 1963). The ecological problem related with phosphatic fertilizers is higher than normal concentrations of phosphorus and nitrogen in water bodies increases the rate of eutrophication. Large amount of inputs of phosphorus in the environment may also discharge from organic manure, detergents, industrial wastes, sewage and sludge (Shaviv, 2000).

Despite this, coated fertilizers have only ever been utilised as nitrogen fertilizers with controlled releases. Diez *et al.* (1992) showed that using coated phosphate fertilizers has definite benefits for preventing phosphorus fixation in calcareous soils.

Controlled-release it was discovered that phosphate fertilizers produced by covering phosphatic fertilizers with wax, conditioner, asphalt, sulphur, wax, and sulphur were useless. This may be because the rate of release of phosphorus from these fertilizer products was much slower than the rate required by crops. However, this suggestion has recently been proven through testing the hypothesis without using specialised P fertilizer products. Therefore, it appears that using controlled-release phosphatic fertilizers could improve crop yields and phosphorous efficiency (Pauly *et al.*, 2001).

Polymer coated fertilizers are seems to affect extractable soil phosphorus and they permit reduction in recommended fertilizer rates. When compared to uncoated fertilizers, coated monoammonium phosphate (MAP) and single super phosphate (SSP) increased soil phosphorus concentrations, phosphorus uptake, and crop yields (Pizzeghello *et al.*, 2019). Sulphur and nitrogen nutrition of plants are metabolically linked (Hawkesford *et al.*, 1994). Sulphur has been shown to increase the efficiency of nitrogen use by crops. The sulphur availability in sufficient form increases N recovery and reduces nitrogen losses (Brown *et al.*, 1999). Sulphur has important role in nodule formation of legumes (Howieson *et al.*, 2000). It acts as catalyst in nitrogen fixation and part of metal-sulphur-cluster (Schneider and Muller, 1999).

Sulfur is a crucial element in the biological fixation of nitrogen. Additionally, it is important for the production of lipids, proteins, vitamins, and sulfur-containing amino acids (cysteine, cystine, and methionine). Despite being crucial for plants, appropriate fertilisation process monitoring was not implemented in the past, which led to the depletion of sulphur stocks. Use of high analysis or sulphur free fertilizers attributed sulphur mining and widespread sulphur deficiencies (Bhudevi *et al.*, 2018). Sulphur response in Indian soils is declined due to multi-nutrient deficiency (Basak *et al.*, 2016). Crop intensification, increased crop removal by high yielding cultivars, and poor soil replenishment due to usage of S-free fertilizers, such as DAP and urea, are the main causes of a rapid drop in the amount of accessible sulphur in soil (Ram *et al.*, 2014). The fertilizers exhibiting different chemical and physical forms are developed

5 to correct sulphur deficiency (Beaton, 1971). These are divided into two categories: sulphate forms and non-sulphate forms, the latter of which must undergo oxidative conversion (chemical forms, which are readily available to plant uptake).

Frequent and successful at reducing sulphur deficiency are the sulphate fertilizers (Janzen and Bettany, 1984). Farmers and manufacturers find the products appealing due to the non-sulphate fertilizers' lower manufacturing and transportation costs and the availability of sulphur nutrients.

The availability of more sulphate across multiple growing seasons and lesser leaching losses increases the appeal of elemental sulphate sources. However, the efficacy of each non-sulphate form varies, and certain elemental sulphur fertilizers perform below expectations. It is challenging to suggest the rate and timing of application for a specific fertilizer product. An opportunity for having to manage soil sulphur fertility exists due to the pattern of nutrient release of available sulphur fertilizers and the variety of sources they come from. This can quickly satisfy the sulphur needs of crops. This will also benefit from keeping a sufficient amount of sulphur that is readily available in the soil and sustain S level over a number of growing seasons from a single fertilizer application. Elemental sulphur is one of best slow-release fertilizer. By changing the particle size of the fertilizer material, it is simple to control the rate of elemental sulphur release.

It is feasible to formulate sulphur fertilizer treatments that are customised to the agronomic requirements of the crops by combining slow-release sulphur and immediately available forms of sulphur (Janzen and Bettany, 1986). There are many sulphur fertilizer sources in the nation, including bentonite sulphur, elemental sulphur, phospho-gypsum, gypsum, and pyrites. Evaluation of their effectiveness in crops like soybean is required.

The enzymes promote nutrient transformations in the soil so that plants and microbes can use them. In comparison to physical or chemical qualities, the biological component of soil reacts quickly to changes in soil condition. Due to the fact that they are a reflection of the effects of soil characteristics and cultivation practises, soil enzymatic activities have been utilised as markers of soil health (Chang *et al.*, 2007). By releasing organic acids, promoting microbial growth, forming chelates with essential plant nutrients, and preventing nutrient fixation, organic sources like

farmyard manure ensure consistent availability of nutrients throughout the crop's growing season. This favours the availability of those nutrients to the crop plants. (Bihari *et al.*, 2018).

The "balance sheet" or "budget" method compares the inputs and outputs of nutrients in the soil-plant system to predict the amount of fertilizer needed for crops. In theory, the amount of nutrients that must be delivered as fertilizer to prevent nutrient mining differs between the outputs and the non-fertilizer inputs (Zebarth *et al.*, 2008). Chemical fertilizers are used in modern agriculture to meet the demand for nutrients.

The demand for nutrients has also increased significantly as a result of increased agricultural yield and production, changing the nutrient balance in the majority of Indian soils toward the negative side (Tandon, 2007). The sustainability of agricultural systems may be severely harmed by the improper use of nutrients. Because of this, having a quantitative understanding of the nutrient depletion from soil resources would undoubtedly aid in the selection of effective nutrient management systems (Pandey *et al.*, 2019).

Conventional fertilizers have a significant disadvantage in that they break down quickly in soil compared to how quickly crops can absorb them. Water runoff thus causes the world around us to become contaminated and lose nutrients from fertilizer. Many researchers are concentrating on the development of slow-release fertilizers (SRF) or controlled release fertilizers in an effort to increase the effectiveness of inorganic fertilizers and reduce the loss of the nutrients they supply (CRF), AlShamaileh *et al.* (2017).

The soil pH, temperature, microbial population, and coating thickness are just a few of the variables that affect how quickly slow-release fertilizers release their nutrients. To decrease nutrient loss and improve fertilizer use efficiency, slow release and controlled release fertilizers have developed and are now widely utilised.

One kind of controlled release fertilizer is coated fertilizer, which is made by physically covering the granules of traditional fertilizers with different ingredients to slow down the rate of breakdown (Dong *et al.*, 2016). In order to release nutrients in a regulated manner and in time with the plants' growing needs, controlled release fertilizers (CRF) are devised and produced in this way.

A perfect controlled release fertilizer delays release so that a single application can provide all the nutrients needed for model crop growth (Azeem *et al.*, 2014). These two terms, controlled release fertilizers (CRF) and slow-release fertilizers (SRF), are thought to be equivalent. In slow-release fertilizers, the pattern of nutrient release is unpredictable and varies depending on the kind of soil and the weather. However, with controlled release fertilizers, it is possible to predict the amount, pattern, and timing of release within certain boundaries (Trenkel, 2010 and Shaviv, 2005). The usage of such fertilizers enhanced fertilizer application efficiency, according to research on slow-release fertilizers (El-Tohamy *et al.*, 2009). For a very long time, the main concerns in the globe have been to improve fertilizer use efficiency and to lessen its harmful effects on the environment (Xiang *et al.*, 2008).

The use of controlled release fertilizers (CRFs) or delayed release fertilizers (SRFs) can reduce nitrogen losses, improve nutrient usage efficiency, and save the environment. In order to achieve higher yield goals, using SRFs or CRFs is therefore regarded as a Best Management Practice (BMP) tool (Liu *et al.*, 2017). It is said that only a small amount of study has been done on the development of controlled release coated fertilizers and their application to oilseeds.

(Azeem *et al.*, 2014). Farmers have the chance to increase NUE by using slow-release and controlled-release fertilizers, particularly in soils with limited cation exchange capacity (Morgan *et al.*, 2009). The following well defined and precise objectives were used to develop and carry out the current research project in the Department of Soil Science and Agricultural Chemistry, College of Agriculture, Vasant Rao Naik Marathwada Krishi Vidyapeeth, Parbhani:

1. To assess the effect of coated fertilizers on growth, yield and quality of Bt cotton.
2. To study the effect of coated fertilizers on soil properties.
3. To examine the effect of coated fertilizers on nutrient content and uptake of nutrients in Bt cotton.

**CHAPTER -II**  
**REVIEW OF LITERATURE**

## CHAPTER II

### REVIEW OF LITERATURE

The role of different nutrient *i.e.*, nitrogen, phosphorus, and sulphur in the crop production is now well established. The crop's reaction to applied nitrogen, phosphorous, and sulphur is primarily dependent on how easily these nutrients are transformed into an accessible form and how the crop uses them.

The efficiency of N, P, and S is typically lower in annual crops. Through denitrification, runoff, volatilization, immobilisation, and leaching, a significant portion of these nutrients are lost. Higher solubility or fixation also have an impact on availability. The use of various slow release and controlled release fertilizers is one of many management strategies that can significantly improve the fertilizer use efficiency.

In addition to frequently used fertilizers, several coated and slow-release fertilizers are entering the market. To increase the effectiveness of nutrient use, it is crucial to understand how various fertilizers release N, P, and S differently. Understanding the availability of nutrients throughout time is made easier by studies on the release pattern of nutrients from coated release fertilizers. If the amounts of N, P, and S from these coated fertilizers match the amounts needed by the cotton, the efficiency of nutrient utilisation can be enhanced.

The benefit of using coated release fertilizers is the reduction of nutrient losses due to leaching and volatilization as well as the extension of the nutrient supply.

The majority of nitrogen uptake by crops takes place when they are at their peak growth. In order to make management decisions, it is important to know when and how much of it is released from coated fertilizers.

Keeping in view the above facts, the studies pertaining to response of cotton to coated fertilizers on growth, quality, yield, nutrient uptake, soil nutrient availability on Vertisols are reviewed and presented under the following sub heads:

**2.1 Effect of coated fertilizers on growth and yield attributes of bt cotton and other crops.**

- 2.1.1 Plant height
- 2.1.2 Number branches per plant
- 2.1.3 Number of bolls per plant
- 2.1.4 Days to maturity
- 2.1.5 SPAD Values

**2.2 Effect of different coated fertilizers on quality of bt cotton and other crops.**

- 2.2.1 Ginning percentage
- 2.2.2 Seed index
- 2.2.3 Lint index
- 2.2.4 Staple length

**2.3 Effect of different coated fertilizers on nutrient content and nutrient uptake in bt cotton and other crops.**

- 2.3.1 Nitrogen content and uptake
- 2.3.2 Phosphorous content and uptake
- 2.3.3 Potassium content and uptake
- 2.3.4 Sulphur content and uptake

**2.4 Effect of different coated fertilizers on micronutrient content and uptake in bt cotton and other crop.**

- 2.4.1 Iron content and uptake
- 2.4.2 Manganese content and uptake
- 2.4.3 Zinc content and uptake
- 2.4.4 Copper content and uptake

**2.5 Effect of different coated fertilizers on soil chemical properties of bt cotton and other crops.**

- 2.5.1 pH

2.5.2 Electrical conductivity

2.5.3 Calcium carbonate content

2.5.4 Organic carbon content

**2.6 Effect of different coated fertilizers on soil available nutrients.**

2.6.1 Available nitrogen

2.6.2 Available phosphorus

2.6.3 Available potassium

2.6.4 Available sulphur

**2.7 Effect of different coated fertilizers on DTPA extractable soil micronutrient.**

**2.8 Effect of coated fertilizer on nutrient use efficiency in bt cotton crop.**

2.8.1 Partial factor productivity

2.8.2 Agronomic efficiency

2.8.3 Apparent nutrient recovery

**2.9 Effect of different coated fertilizers on economics of different crops.**

**2.1 Effect of coated fertilizers on growth and yield attributes of bt cotton and other crops**

**2.1.1 Plant height**

In all three coated fertilizers (sulfur coated urea, phosphogypsum coated urea, and gypsum coated urea), the height of the rice plant was shown to be significantly higher at 45 and 75 days after transplanting as compared to uncoated urea. The maximum plant height (113.7 cm) was reported in the sulphur coated urea treatment, which was significantly higher than uncoated urea (107 cm) and on par with phosphogypsum coated urea (111.7 cm) and gypsum coated urea (111.7 cm) (Shivay *et al.*, 2015).

Yaseen *et al.* (2017) field studies were done to investigate the impact of polymer-coated diammonium phosphate (DAP) in the maize-wheat cropping system. Plant height was significantly higher (32%) when 75 percent of the prescribed fertilizer dose was applied using polymer-coated DAP fertilizer.

Ali *et al.* (2017) examined how wheat's growth, yield, and phosphorus utilisation efficiency were affected by polymer-coated diammonium phosphate. Wheat height responded positively to the stimulatory effects of polymer-coated DAP. According to their findings, applying DAP that had a 100% polymer coating improved plant height by up to 19% compared to commercial DAP. Wheat plant height raised by up to 4% when commercial DAP was applied that was 50% polymer coated.

Application of the complete recommended dose via polymer-coated DAP raised wheat plant height by 13.4% over control and by 4.1 above DAP that wasn't coated. In comparison to the control treatment, the treatments using various rates of polymer coated DAP increased plant height (Noor *et al.*, 2017).

Rice plants grew taller when the amount of slow-release sulphur fertilizers was increased. The application of Gromor Rapid Blue® @ 10 kg acre<sup>-1</sup> resulted in the highest plant height (112 cm) at harvest, and it was followed by plant height (110.7 cm) recorded in 7.5 kg of Gromor Rapid Blue® acre<sup>-1</sup>. Bentonite sulphur treatment increased the plant's metabolic processes, which improved growth indicators (Bhudevi *et al.*, 2018).

The effect of graded levels of potassium and zinc on growth, yield and quality of pigeon pea was studied. The results indicated that various growth and yield parameters like plant height, seed yield content was increased due to application of 30 kg potassium with 15 kg zinc along with RDF (Thamake *et al.*, 2019).

### **2.1.2 Number branches per plant**

Singh and Kushwaha (2013) conducted a field experiment to study the effect combined application of nutrients like sulphur, boron along with RDF for yield properties and yield of soybeans. Treatment consisted of five levels of sulfur (0, 10, 20, 30 and 40 kg ha<sup>-1</sup>) and five boron levels (0, 0.5, 1.0, 1.5 and 2.0 kg ha<sup>-1</sup>) along with the recommended dose of NPK through inorganic fertilizers. The results revealed that a basal application of RDF together with 30 kg S and 1.5 kg B per ha<sup>-1</sup> recorded significantly the highest number of tillers per soybean plant. Balanced nutrient fertilization improved soybean yield and yield characteristics.

Begum *et al.* (2015) conducted a field experiment to study the effects nitrogen and phosphorus nutrition for attributed growth and yield. It was observed that,

combined application of 25 kg N with 54 kg P ha<sup>-1</sup> through inorganic fertilizers the result was the highest number of branches (2.63) and seeds plant<sup>-1</sup> (94.93), plant height (34.18 cm), seed yield (1.95 t ha<sup>-1</sup>) and stover (1.95 t ha<sup>-1</sup>).

Ghodke *et al.* (2018) conducted an experiment to investigate the response rain soybeans for the combined use of organic and inorganic nutrient sources. It was observed that the significantly highest plant height and number of branches per plant in treatment with application of 100% RDF + 45 kg S ha<sup>-1</sup> + 10 t FYM ha<sup>-1</sup> + Biofertilizer in all growth stages of soybeans. NPK dosage using inorganic fertilizers is also advised.

Shilewant *et al.* (2020) conducted field experiment to study the effect of soil and foliar feeding of nutrients through organic and inorganic sources on yield and quality of sweet orange (*Citrus Sinensis* L. Osbeck). The study indicates that, application of NPK in 8 Splits with drip irrigation + vermicompost @ 3 tonne ha<sup>-1</sup> and biofertilizers *i.e.*, Azotobacter and PSB @ 2000 ml ha<sup>-1</sup> and Trichoderma @ 1 kg ha<sup>-1</sup> + 8 spraying of Zn (0.5%), Fe (0.5%) and B (0.2 %) found to be most effective to producing number of fruits, weight of fruits and yield and fruit quality parameters like ascorbic acid, TSS, acidity and total sugar percentage.

### **2.1.3 Number of bolls per plant**

Li *et al.* (2020) studied that the cotton boll yield, lint percentage and lint yield were not affected by treatments. Boll yield was 16% greater whereas lint percentage was 7 % lower in 2016 than 2015. As a result, lint yield was similar between the two-crop year with an average of 1.1 mg ha<sup>-1</sup>. There was no interaction effect between year and treatment on boll yield, lint percentage and lint yield.

### **2.1.4 Days to maturity**

Nutritional effects on nitrogen and sulphur on the number of maturity days were investigated. The treatments receiving only 140 kg N ha<sup>-1</sup> had the highest number of days to maturity (160.3) (Yasir *et al.*, 2015).

The impact of ammonium sulphate applied foliarly on the number of canola maturity days was investigated. The findings showed that, in comparison to the other treatments, the control treatment had the highest number of maturity days (484). The treatment using a 1% foliar spray of ammonium sulphate resulted in the minimum maturity days (469.5) being recorded (Anjum *et al.*, 2018).

### **2.1.5 SPAD Values**

Geng *et al.* (2016) revealed that the SPAD values were considerably affected by N and S fertilization, and also by their interaction, except that in squaring and full boll-opening stages. Under PCU fertilization treatments, the SPAD value were higher compared with urea treatment, and PCU X S60 treatment achieved the highest SPAD value in each ontogenic stage, but there was no significant difference among PCU X S60, PCU X S120 and urea X S60 treatments.

## **2.2 Effect of different coated fertilizers on quality of bt cotton and other crops.**

### **2.2.1 Ginning percentage**

Watts *et al.* (2014). Revealed that the Ginning percentage, the weight of lint as a percentage of the machined picked seed cotton, differed among years. Averaged across N treatments, ginning percentage was highest in 2009 and lowest in 2011. The highest ginning percentage occurred during the year with the greatest precipitation. Averaged across years, ginning percentage was higher in the control and both PL (Poultry litter) treatments than in the EENFs (Enhanced-efficiency nitrogen fertilizer) and inorganics. The trend of higher ginning percentages for PL (Poultry litter), PLA (Poultry litter + AgrotainPlus) and C tended to occur across all 3 years. The fact that the control had a high ginning percentage was expected since it has been shown that low N supply increases ginning percentage (Tewolde *et al.*, 2007) because N deficiency negatively affects seed growth more than lint growth (Tewolde *et al.*, 2008).

### **2.2.2 Seed index**

In comparison to the SSP, gypsum, and elemental S treatments, the Bentonite-S as a source of sulphur recorded significantly the highest test weight (21.1 g) of rice treatments (Shivay *et al.*, 2014).

The purpose of the study was to assess sulfate-coated urea as a sulphate source in wheat. It was not possible to find sulphur-coated urea with graduated degrees of sulphur coating. As a result, sulphur-coated urea with a 1, 2, 3, 4, and 5 percent sulphur coating on prilled urea was employed in the current investigation. Finely powdered commercial grade sulphur with a 90% purity level and a 1:1 aqueous solution of gum acacia were also used as an adjuvant. Wheat grain weight rose considerably when nitrogen was applied as sulphur-coated urea compared to the

absolute control and uncoated urea. The treatment with 5% sulphur coated urea (42.3 g) recorded the significantly higher test weight, which was comparable to the treatments with 4% sulphur coated urea (41.4 g) and 3% sulphur coated urea (40.8 g). 39.3 g of test weight were recorded for the uncoated urea treatment (Shivay, 2016). With the administration of 50% and 100% doses of polymer coated DAP, the test weight of wheat increased by 2% and 16%, respectively (Ali *et al.*, 2017).

To examine its impact on growth and yield, the controlled release phosphatic fertilizer was tested on a wheat crop. Test weight in wheat increased by 16% during the treatment using the full recommended rate of polymer-coated DAP fertilizer compared to the recommended rate of uncoated DAP fertilizers (Noor *et al.*, 2017).

Dhamak *et al.* (2018) conducted field experiment to study effect of potassium levels and foliar spray of micronutrients on growth, yield and nutrient uptake by green gram. The growth and attributes like plant height, seed yield and dry matter yield were significantly improved by the application of potassium and micronutrients along with RDF.

Todmal *et al.* (2022) conducted field experiment to study the influence of different slow release and controlled release fertilizers on yield and nutrients dynamics in soybean production. The seed and straw yield of soybean were recorded significantly highest in the treatment with RDF through CDU + Polymer coated DAP + Bentonite Sulphur.

### **2.2.3 Lint index**

Geng *et al.* (2016) Conclude that the release rate curve pattern of PCU synchronized with N requirements of cotton. Lint yield and fiber qualities were significantly affected by the types of N. S fertilization, and their interaction. The maximum lint yield and (Relative Use Efficiency) RUE were achieved with PCU and 60 kg ha<sup>-1</sup> S fertilizer, which was 5.54-11.17% and 57.86% higher in comparison with urea treatments and SO.

### **2.2.4 Staple length**

Geng *et al.* (2016) concluded that the compared to control, the fiber quality was marked improved by N and S fertilization. There were obvious differences among the N-fertilized treatments, where the PCU treatments were higher than the urea treatments in fiber length, fiber uniformity and fiber strength. Moreover, fiber

length and uniformity was affected by the interaction of N and S. The fiber length and strength in S60 and S120 was increased compared with SO. No difference was observed about micronaire and fiber elongation among treatments.

## **2.3 Effect of different coated fertilizers on nutrient content and nutrient uptake in bt cotton and other crops.**

### **2.3.1 Nitrogen content and uptake**

The urea treatment recorded a significantly higher plant N concentration over the control (2.89 %), with the highest N concentration (3.32 %) with urea + pyrite + copper sulphate. Due to a larger dry matter yield and higher N concentration, altered urea fertilizers greatly increased the sunflower's total nitrogen intake when compared to unamended urea. Urea plus pyrites, urea plus pyrites plus copper sulphate, urea plus KCl, and urea plus KCl plus copper sulphate all enhanced total nitrogen uptake as compared to unamended urea by 73, 170, 70, and 143 mg pot<sup>-1</sup> respectively. The chemical additives were shown to be useful as fertilizer in addition to being effective. In reducing urea ammonia loss and increasing N utilisation effectiveness. Therefore, it is a possibility to change urea using chemical additions (Reddy and Sharma, 2000).

On the uptake of nitrogen by hybrid rice, the impact of coating prilled urea with environmentally friendly neem (*Azadirachta indica* A. Juss.) formulations was investigated. The coating of urea with 2 percent neem cake powder by weight was done with the aid of coaltar and kerosene (1:2) at a rate of 2 ml 100 g<sup>-1</sup> urea and it was applied at 120 kg N ha<sup>-1</sup> to create Pusa Neem Golden Urea (PNGU), Karanj Emulsified Coated Urea (KEU), Tri-neem Coated Urea (TNU), Pusa Neem Oil Micro Between two rice varieties, nitrogen levels, and sources, there were noticeable variations in N uptake with relation to grain, straw, and total biomass. NDHR-3, a hybrid rice variety, has nitrogen uptake in the grain and straw of 40.7 and 45.4 kg ha<sup>-1</sup>, respectively, as opposed to 24.5 and 26.6 kg<sup>-1</sup> for Pusa Basmati-1. It was as a result of the conventional variety's lower grain and straw production. In terms of nitrogen's sources in comparison to prilled urea, Pusa Neem Golden Urea and Tri-neem Coated Urea considerably increased grain, straw, and total nitrogen intake (while other sources were statistically equal) (Singh and Shivay., 2003).

In comparison to other coating levels of neem oil on prilled urea, the treatment of 1000 mg neem-oil kg<sup>-1</sup> increased the nitrogen uptake in rice. Total N uptake (grain

+ straw) was considerably altered by coating prilled urea (PU) with neem oil of increasing thickness. When urea was coated with 1000 mg of neem oil per kilogramme, the greatest nitrogen uptake ( $154.6 \text{ kg ha}^{-1}$ ) was observed. As the neem-oil coating thickness increased, the nitrogen uptake considerably reduced (2000 mg neem-oil  $\text{kg}^{-1}$  PU), Kumar *et al.* (2010).

Neem oil components' various doses had a substantial impact on how much nitrogen was taken in overall. The urea coated with meliacins had the highest total N uptake ( $126.1 \text{ kg ha}^{-1}$ ), which was significantly greater than the urea coated with other neem oil components (FFA, pure oil, saturated and unsaturated fractions). When compared to uncoated (prilled) urea alone, several neem oil components (@ 500 mg  $\text{kg}^{-1}$ ) were found to significantly boost rice's overall uptake of nitrogen (Kumar *et al.*, 2011).

Under greenhouse conditions, the impact of sulphur and the urease inhibitor agrotain on rice's uptake of nitrogen was investigated. As slow-release fertilizers, sulphur and urease (agrotain) coated urea considerably enhanced the N uptake by the rice crop when compared to granular urea (GU) and the control treatment. In comparison to urea coated with sulphur and urease (agrotain), the rate of urea dissolution was quicker. In the treatment, urea that had been coated with sulphur and urease (agrotain) absorbed more nitrogen. The considerable amount of volatilization and leaching of alkaline calcareous soils was the cause of the reduced nitrogen uptake observed in uncoated urea treatments (Khan *et al.*, 2015).

### **2.3.2 Phosphorous content and uptake**

In comparison to thick coated polymer and shrink-wrap treatments, coating monoammonium phosphate with a thin coated polymer led to better phosphorus uptake and dry matter yield in barley. In the early phases of barley growth, uncoated monoammonium phosphate showed better dry matter yield and phosphorus uptake than polymercoated monoammonium phosphate. The later stages of crop growth, however, saw a reversal of this pattern (Pauly *et al.*, 2001).

The effectiveness of phosphorus utilisation in various field crops was improved using polymer technology. The findings showed that, under a variety of soil conditions and crop types, the Avail polymer has beneficial impacts on the availability and uptake of fertilizer phosphorus. Higher yields and higher-quality

crops have resulted from improved phosphorus availability and uptake (Sanders *et al.*, 2012).

Compared to traditional fertilizers, the controlled release fertilizer has enhanced the phosphorus uptake in grain and straw in the wheat crop. It was found that applying a full dose of fertilizer by polymer-coated DAP caused the absorption of phosphorus in grain and straw to increase to 24 and 27 kg ha<sup>-1</sup>, respectively (Ali *et al.*, 2017).

The treatment that used polymer coated DAP at a 100 percent guideline rate above application of uncoated DAP saw the highest increase in phosphorus uptake (116%). Additionally, it was noted that treatment with 75 percent and 50 percent of the recommended rate of polymer coated DAP over uncoated DAP increased total phosphorus uptake by 27 and 68 percent, respectively (Noor *et al.*, 2017).

Swami *et al.* (2019) conducted field experiment to study the effect of ammonium molybdate on nutrient status and yield of pigeon pea growth in vertisol. The results found Available macro and micronutrients at various growth stages of pigeon pea found to be decreased continuously from flowering to harvesting due to plant uptake of nutrients for their vegetative and reproductive growth. The yield parameters like seed yield and stover yield was increased due to application of RDF + Ammonium molybdate through foliar application @ 0.5%.

### **2.3.3 Potassium content and uptake**

In pot studies, the impact of slow-release fertilizer on the accumulation of dry matter and nutrient uptake by soybean crops was investigated. During the growing season, dry matter accumulated more in all treatments than in the control. Slow-release fertilizers boosted soybean K<sup>+</sup> uptake and absorption to some extent Zhang *et al.* (2002).

The use of various naturally oil-coated urea slow-release fertilizers considerably enhanced the total potassium uptake in maize. The treatment that received the full recommended nitrogen dose through neem coated urea as basal recorded a significantly higher potassium uptake (110.95 kg ha<sup>-1</sup>); it was comparable to the treatments that received the full recommended nitrogen dose through pongamia oil coated urea as basal (107.48 kg ha<sup>-1</sup>), castor oil coated urea as basal (110.30 kg ha<sup>-1</sup>), and 75 percent recommended nitrogen dose through (97.69 kg ha<sup>-1</sup>). Due to the

positive link between nitrogen and potassium, it was shown that the overall intake (grain plus straw) increased with increased nitrogen uptake. The biological activity of soil organisms and the release of nutrients from sources were the key factors influencing the uptake of these nutrients (Shilpha *et al.*, 2017).

Ahmed and Fahmy (2017) analysed the effects of neem cake-coated urea and nano iron foliar sprays on the rationalisation of chemical nitrogen fertilizers and wheat yield. When compared to uncoated fertilizer, it was shown that neem-coated urea, whether or not it also contained foliar applications of nano-Fe, significantly enhanced the nitrogen, phosphorus, and potassium content and uptake of wheat. Following 100% neem cake coated urea, 100% neem cake coated urea had the highest level of nutrient absorption.

Ha *et al.* (2018) completely new controlled-release fertilizers with various dissolving rates were created, and their impact on Phalaenopsis leaf concentration was studied. It was discovered that the Phalaenopsis leaf with the highest potassium concentration (2.82%) was produced by the new controlled-release fertilizer I @ 1.0 g pot<sup>-1</sup>.

Ghafoor *et al.*, (2021) conducted a field experiment to investigate the impact of several coated urea fertilizer types on wheat's uptake of NPK. The findings showed that coated N-based fertilizers and P and K had synergistic effects. The treatment of 130 kg ha<sup>-1</sup> N using bioactive sulphur coated urea resulted in the noticeably greatest P and K absorption (kg ha<sup>-1</sup>) ever measured (BSCU).

### **2.3.4 Sulphur content and uptake**

Agrawal *et al.*, (2000) conducted a field experiment to investigate the effects of P and S on sunflower (*Helianthus annuus* L.) yield, concentration, and uptake of N, P, and S. Four levels of P (0, 30, 60, and 90 kg ha<sup>-1</sup>) and four levels of S made up the treatments (0, 20, 40 and 60 kg ha<sup>-1</sup>). It was found that adding sulphur using bentonite sulphur improved the concentration and uptake of N, P, and S in sunflower seed and straw during various growth stages.

Dhage and Patil (2008) conducted a field experiment to investigate how sulphur sources affected sunflower yield and S uptake. Four levels of S (0, 20, 40, and 60 kg S ha<sup>-1</sup>) and two sources of S (gypsum and Gromor Sulphur Pastilles) made up

the therapy. The treatment with NPK + 60 kg ha<sup>-1</sup> Bentonite S exhibited the maximum nutritional uptake of N, P, K, and S, and was considerably higher than control.

The uptake of sulphur by mustard, the effects of various sulphur sources and dosages were investigated by Kumar *et al.*, 2018. Gypsum, iron pyrite, and bentonite S were combined as one of three sulphur sources, and four amounts (0, 20, 40, and 60 kg S ha<sup>-1</sup>) were used in the treatment. Due to increased seed and stover yields and higher sulphur content discovered in bentonite S treatment, the maximum total sulphur uptake (30.71 kg ha<sup>-1</sup>) was seen when compared to the other two sources of sulphur.

## **2.4 Effect of different coated fertilizers on micronutrient content and uptake in bt cotton and other crop**

### **2.4.1 Iron content and uptake**

Shambhavi *et al.* (2018) examined the impact of ongoing fertilisation on wheat and maize uptake of Fe. It was discovered that the 100 percent NPK + FYM treatment resulted in the maximum overall uptake of Fe by wheat (1473.2 g ha<sup>-1</sup>) and maize (2223.1 g ha<sup>-1</sup>). In comparison to the control treatments, the total uptake of Fe by both crops was noticeably higher in the fertilizer-treated treatments. The optimal availability of iron due to the proliferous root system generated under balanced nutrient treatment may be responsible for the considerable increase in iron uptake with the application of RDF (NPK).

More *et al.* (2019) carried out the survey to evaluate the nutrient status and to correlate the chemical properties with the nutrients like macro and micro nutrients of Basmat tahsil of Hingoli District. The results indicates that organic carbon showed positive significant correlation with available N and DTPA extractable Fe, CaCO<sub>3</sub> showed positive significant association with available K and DTPA, Cu and Mn.

A field experiment was conducted to investigate the impact of integrated nutrient management on the yield and uptake of micronutrients by maize-wheat in the cropping sequence. With the application of 100 percent NPK + FYM 10 t ha<sup>-1</sup>, the maximum iron, copper, and manganese content in grain and stover of maize and wheat was discovered (Priyanka *et al.*, 2019).

Paramesh *et al.* (2020) the impact of INM and agronomic fortification of zinc on wheat quality, yield, and nutrient uptake. The findings showed that applying 50

percent phosphorus through chemical fertilizer and 50 percent phosphorus through phosphorus-enriched compost led to a significant increase in Fe concentration and uptake, which was then followed by applying 100 percent phosphorus through phosphorus-enriched compost over a control treatment that did not apply phosphorus and 100 percent phosphorus through fertilizer. 13.4 percent was found to be the increase in wheat grain Fe concentration over 100% phosphorus due to fertilizer application. Plots without P had the lowest Fe content and absorption.

#### **2.4.2 Manganese content and uptake**

Walia and Kler (2010) The effects of organic and inorganic nutrient sources on macro and micronutrient intake in the maize-wheat cropping sequence were studied in a field experiment. In a maize-wheat cropping sequence, a field experiment was conducted to examine the effects of organic and inorganic nutrient sources on macro and micronutrient uptake. In comparison to pure inorganic treatment, same treatment measured 10.80 mg g<sup>-1</sup> DTPA extractable soil Mn, which was 96.4 percent greater. With 20 t ha<sup>-1</sup> FYM and crop residue assimilation, 120:60:40 N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O was used.

Dhaliwal *et al.* (2014) examined how manures and fertilizers affected the concentration and absorption of micronutrients in rice and wheat grain and straw. The findings showed that the treatments using organic manure plus chemical fertilizers had the highest concentrations of Zn, Cu, Fe, and Mn in wheat grains (26.74, 4.93, 39.18, and 24.60 mg kg<sup>-1</sup>, respectively) and rice grains (27.07, 2.97, 36.72, and 52.28 mg kg<sup>-1</sup>, respectively). Similar to this, treatments that applied both chemical and organic fertilizers saw the maximum uptake of Zn, Cu, Fe, and Mn (123.1, 23.6, 189.4 and 112.1 g ha<sup>-1</sup>, respectively) in wheat grains and (158.4, 17.3, 194.0 and 306.1 g ha<sup>-1</sup>, respectively) in rice grains.

The purpose of the experiment was to examine the uptake of micronutrients in the Dharwad soils used for producing soybeans. Manganese uptake ranged from 104.13 to 162.16 g ha<sup>-1</sup> in the category of above average yield, with a mean value of 134.25 g ha<sup>-1</sup>. The higher production of dry matter in the category of above average yields was the cause of the increased uptake of manganese (Sheker *et al.*, 2017).

### 2.4.3 Zinc content and uptake

Sreemannarayana *et al.* (1993) examined how applying sulphur affected zinc absorption. The findings showed that sunflower stalk 32 (82.54 kg ha<sup>-1</sup>) and the head (39.03 g ha<sup>-1</sup>) absorbed the most zinc when sulphur was applied at a rate of 60 kg ha<sup>-1</sup> through ammonium sulphate. The higher uptake of zinc caused by the application of sulphur may have been caused by an increase in the capacity of the crop to utilise more nutrients, including zinc, as a result of improved growth and vigour when S is used.

Patil (2018) conducted a field experiment to examine how the maize-onion cropping cycle on Inceptisol was affected by slow-release nitrogen fertilizers on soil, yield, and micronutrient nutrient uptake. The appropriate dose of nitrogen using neem coated urea considerably increased the content and uptake by maize of the micronutrients (Fe, Mn, Zn, and Cu) (NCU). The aftereffect of slow-release nitrogen fertilizers on the subsequent onion crop also had an impact on the uptake of macro- and micronutrients.

The enhancement in micronutrient content and uptake through N and S supplementation in spring rye was the subject of an experiment. Four dosages of N (0, 30, 60, and 90 kg ha<sup>-1</sup>) and two doses of S were used in the treatment (0 and 40 kg ha<sup>-1</sup>). Sulfur-based NPK fertilisation increased Fe, Mn, Zn, and Cu content and absorption (Klikocka *et al.*, 2020).

### 2.4.4 Copper content and uptake

In calcareous soils with a rice-wheat system, the impact of residual zinc and crop residue incorporation on soil micronutrient content and uptake was investigated. Crop leftovers were added, which increased the availability of micronutrients in the calcareous soils. Different agricultural residue concentrations significantly boosted the uptake of copper by wheat and rice by 49 and 36%, respectively (Kumari *et al.*, 2017).

A field experiment was done to examine how different nitrogen and sulphur doses affected the amount of iron, manganese, copper, and zinc and how well it was absorbed by wheat. The experiment included two applications of sulphur and four doses of nitrogen fertilisation (0, 40, 80, and 120 kg ha<sup>-1</sup>) (0 and 50 kg ha<sup>-1</sup>). When

sulphur is added to NPK fertilizers, the concentration and uptake of the micronutrients Fe, Mn, Zn, and Cu in wheat are increased (Klikocka and Marks 2018).

Pandey (2018) conducted a field experiment to see how oat productivity and nutrient uptake were affected by integrated nutrition management. N, P, K, S, Fe, Cu, and Zn content and absorption were found to be highest in the treatment with application of 75% NPK + 5 t FYM + 20 kg S ha<sup>-1</sup> and lowest in the control. The amounts of Cu and Zn that are readily available with 75% NPK + 5 t FYM + 10 kg Mn ha<sup>-1</sup>.

## **2.5 Effect of different coated fertilizers on soil chemical properties of bt cotton and other crops**

### **2.5.1 pH**

In a rotation of maize and wheat, a field experiment was conducted to examine the impact of inorganic and organic fertilizers on the chemical characteristics of the soil. Utilizing both organic and inorganic fertilizers in a balanced and integrated manner increased the build-up of soil organic matter and enhanced the physical characteristics of the soil. When various fertilizers were applied, the pH of the soil fell in comparison to the control treatment. Due to the accumulation of organic matter in fertilizer plots, the pH of the soil decreased (Brar *et al.*, 2015).

A laboratory experiment was done to see how different organic materials affected the pH of calcareous soil. It was discovered that adding various organic soil amendments caused the pH of the soil to fall. Decomposition of organic materials, nitrification processes, and oxidation of organic substances all contributed to a little drop in soil pH (Barka *et al.*, 2018).

Dhamak *et al.* (2020) studied the long- term effect of integrated nutrient management on soil organic carbon fractions in vertisol under sorghum wheat cropping system. The study showed that there was slight decrease in bulk density and calcium carbonate increase in porosity and water holding capacity and slightly increase in pH and EC of soil over 33 years of sorghum- wheat cropping system receiving organic manures in combination with inorganic fertilizer.

It was investigated how applying biochar-coated urea affected the characteristics of the soil. Eight treatment combinations made up of two nitrogen fertilizer suppliers, two nitrogen fertilisation rates, and biochar made up the

experiment. The results showed that soil pH was higher in control treatment (6.17) than in urea treatments (U1- 5.95, U2- 5.89), as well as in urea treatments with biochar coating (BCU1- 6.10, BCU2- 6.03). Between the control, Urea1 + biochar, and Urea2 + biochar, there was no discernible difference in soil pH (Jia *et al.*, 2021).

### **2.5.2 Electrical conductivity**

In Vertisol, the impact of neem coated urea (NCU) on soil characteristics at rice crop harvest was investigated. Electrical conductivity (EC), which measures the total soluble salt concentration, was found to be substantially greater ( $0.26 \text{ dS m}^{-1}$ ) in 125 percent NCU (3 split) compared to 100 percent NCU- 2 splits ( $0.25 \text{ dS m}^{-1}$ ) and 75 percent NCU- 3 divides ( $0.24 \text{ dS m}^{-1}$ ). The control treatment had the lowest EC ( $0.23 \text{ dS m}^{-1}$ ), Khandey *et al.* (2017).

The impact of sulphur and fertilizer amounts on clay loam soil characteristics was investigated. The findings showed that as fertilizer levels grew, so did electrical conductivity. Farmers' practise ( $T_2$ ) had the highest electrical conductivity ( $0.52 \text{ dS m}^{-1}$ ), while control had the lowest ( $0.39 \text{ dS m}^{-1}$ ) ( $T_1$ ). Except for the farmers' practise ( $T_2$ ), all the treatments were comparable to the control ( $T_1$ ). Mineral fertilizers with soluble salts boosted the electrical conductivity of the soil. Application of sulphur also improved electrical conductivity (Deekshitha *et al.*, 2017).

Under the rice-wheat cropping system, the long-term impacts of inorganic fertilizers and FYM on soil chemical characteristics and wheat yield were investigated. The trial included fourteen different combinations, including using chemical fertilizers alongside FYM and applying N, P, and K fertilizer separately. By raising soil pH, EC, and wheat yield in both the surface and deeper layer of soil, combined application of inorganic fertilizer and FYM produced a favourable influx of nutrients. Under N + P + K + FYM treatment, the highest EC ( $0.33 \text{ dS m}^{-1}$ ) was noted (Bhatt *et al.*, 2017).

### **2.5.3 Calcium Carbonate content**

The effects of fertilisation methods on soil pH and calcium carbonate were investigated. The findings showed that fertilisation treatments considerably decreased the amount of calcium carbonate in the soil, with the NPKS treatment showing the largest reduction. Additionally, it was shown that the same treatment with NPKS

resulted in more severe soil acidification because to the greater H<sup>+</sup> intake and reduced pH buffering ability (Zhang *et al.*, 2016).

The impact of various organic materials on the chemical characteristics of soil was investigated. The findings showed that the pH and CaCO<sub>3</sub> content of the soil were modestly lowered by three organic amendments (Barka *et al.*, 2018).

Ghodke and Takankhar, (2020) investigated how soil characteristics were affected by integrated nutrient management. It was found that the various treatments had no appreciable impact on the soil's CaCO<sub>3</sub> composition. However, compared to the initial calcium carbonate content (5%) of the soil, higher calcium carbonate content (4.95%) was found in the control treatment (T<sub>1</sub>), and lower calcium carbonate content (4.15%) was found in the application of 50% RDF + 10 t FYM ha<sup>-1</sup> + 45 kg S ha<sup>-1</sup> + Biofertilizer (T<sub>8</sub>) at soybean harvest. Because enough organic matter was added to the soil, the amount of calcium carbonate decreased.

#### **2.5.4 Organic carbon content**

Cow dung, rice bran, dried neem leaf powder, clay, and other agricultural wastes were used to create the organic matter entrapped urea (OMEU). The entire agro-waste was ground and blended in ratios of 1:1:1:1. To prepare OMEU, a 2:1 mixture of agricultural waste (supporting matrix) and fertilizer urea was used. As a binder, the 25% saresh (plant gum of *Acacia* sp.) was utilised. The application of urea with organic matter trapped inside had a considerable impact on the soil's organic carbon (OMEU). Compared to the initial value of organic carbon (0.33%) and fertilizer urea (0.31%), the organic carbon was increased with the application of OMEU (0.35%) Kumar *et al.* (2013).

In a maize-wheat cropping system, the impact of polymer-coated diammonium phosphate on soil organic carbon was investigated. The application of polymer-coated diammonium phosphate fertilizer enhanced the physical, chemical, and microbiological characteristics of the soil, which in turn impacted how plants absorbed phosphorus (Yaseen *et al.*, 2017).

Khandey, (2017) examined how neem coated and prilled urea affected rice yield and soil characteristics. Soil organic carbon was found significantly higher (0.58 percent) in the treatment 125 percent NCU (3 split) and it was followed by soil organic carbon content (0.57 per cent) recorded in the treatment 100 percent NCU (2

split 75 percent + 25 percent) at 30 DAT. At 60 DAT organic carbon was found non-significantly higher (0.62 percent) in the treatment 125 percent NCU (3 split). At rice harvest, the treatment's 125 percent NCU maximum organic carbon content (0.55 percent) was reported (3 split). With the application of NCU, the organic carbon content of the soil increased.

## **2.6 Effect of different coated fertilizers on soil available nutrients.**

### **2.6.1 Available nitrogen**

Green, (1967) evolved technique for making sulphur-coated urea. Formaldehyde and elemental sulphur were employed to prepare the sulfur-coated urea. In SCU, formaldehyde served as a binding agent and elemental sulphur served as a coating substance. Urea is slowly released into the soil by methylol derivatives created at the point where it comes into contact with formaldehyde and a layer of sulphur.

The impact of slow-release multi-nutrient fertilizers (NPK) on the soil fertility status of turmeric at various growth stages was investigated. With higher nutrition levels, the nitrogen availability was significantly boosted. Increased quantities of NPK in the form of tablets considerably improved the soil's available nutrient status at 90 DAS, 180 DAS, and at harvest. The tablets maintained both nitrogen status and nitrogen release from the tablets by slowly releasing nitrogen and reducing losses from NH<sub>3</sub> volatilization and leaching (Jagadeeswaran *et al.*, 2007).

It was investigated how neem coated urea affected yield and lingering soil fertility. It was found that neem- and oil-coated urea provided crops with slow-release nitrogen. Nitrogen losses and nitrification rates both decreased. After the harvest of both rice and wheat, neem coated urea treatment showed a modest increase in available nitrogen status compared to uncoated urea (Singh *et al.*, 2019).

The release of soil-available nitrogen was tested in laboratory incubation research using urea fertilizer (DMU) containing 1 percent (W/W) of the nitrification inhibitor 3,4-dimethylpyrazole phosphate (DMPP). The findings showed that urea placed deep into the soil suppresses nitrification in a manner similar to how lime nitrogen behaves until eight weeks (Hatano *et al.*, 2019).

Beig *et al.* (2020) examined the delayed release urea prills made from organic and inorganic blends in a fluidized bed coater's nitrogen release pattern. As a

biodegradable coating material for urea prills, the coated urea was made from polymeric materials in combination with inorganic elements like sulphur and plaster of Paris. Molasses and paraffin wax were utilised as binders. Four different formulas were used to coat the urea: C-1: PVA 5%, plaster of Paris 10%, sulphur 5%, and paraffin wax 2%; C-2: PVA 5%, starch 10%, sulphur 5%, and paraffin wax 2%; and C-3: PVA 5%, starch 10%, sulphur 5%, and paraffin wax 2%. C-3: paraffin wax 2 percent, gelatin 5 percent, plaster of Paris 10 percent, sulphur 5 percent, PVA at 5%, starch at 10%, sulphur at 5%, paraffin wax at 2%, and molasses at 2% make up C-4. In order to slow down N release, it has been found that covering urea prills with organic and inorganic mixtures is preferable.

### **2.6.2 Available phosphorus**

Lindsay *et al.* (1989) found that a little portion of the coating was dissolved as a result of water passing through the coating and vapours condensing on the solid core. The coating's thickness was increased to prolong the availability of phosphorus.

In a pot culture experiment with barley, it was found that polymer coating of phosphorus fertilizer granules (Monoammonium phosphate and Diammonium phosphate) led to a rather slow, but consistent supply of phosphorus that was available to plants when it diffused or seeped through the coating (Nyborg *et al.*, 1995).

The 10 percent by weight polyvinyl alcohol (PVA) solution, 1 percent by weight chitosan solution, and 2 percent by weight acetic acid were combined to create the control release fertilizer hydrogels. Among the hydrogels made with controlled release fertilizers (CRF), chitosan (CS) hydrogel had the largest cumulative release of phosphorus in soil. The water retention of soil was increased by all CRF hydrogels (Jamnongkan and Kaewpirom, 2010).

Varadachari and Goertz (2010) investigated the phosphorus release mechanism from coated phosphatic fertilizers. Each fertilizer granule is enclosed in a coating made of an insoluble polymer. The findings showed that water reaches through the covering to dissolve the fertilizer core. The fertilizer solution inside the particle is carried through the coating during solubilization and subsequently released into the soil environment.

Wheat crop phosphorus availability in the soil was investigated when controlled release phosphatic fertilizers were used. In comparison to uncoated DAP,

the availability of phosphorus decreased with the number of coating layers and days of incubation. In comparison to all coating treatments and uncoated DAP, double layer polymer coating on DAP fertilizer showed a maximisation trend of P release in soil and was matched with plant requirements for phosphorus (Noor *et al.*, 2017).

### **2.6.3 Available potassium**

It was investigated how long-term intense cropping impacted soil potassium. Nitrogen fertilizer applications alone had a negative impact on soil productivity, especially in phosphorus and potassium-deficient soils. These plots' potassium availability status decreased to below-critical levels, whereas greater potassium pools were maintained in the 150 percent NPK and 100 percent NPK + FYM plots (Samra and Swarup 2002).

A grazing system's nitrogen, phosphorus, and potassium losses were investigated. Overall K losses were found to be negligible, most likely as a result of K not being added as inorganic K (Alfaro *et al.*, 2008).

Due to the organic matrix-entrapped biofertilizers' minimal loss of nutrients from the soil and their gradual release procedure, the availability of nutrients in soil was improved. In addition, soil's organic matrix is a good supplier of nutrients. In comparison to treatments using biofertilizers II (251.03 kg ha<sup>-1</sup>) and no fertilizer (218.81 kg ha<sup>-1</sup>) in rice, application of organic matrix imprisoned biofertilizers increased soil accessible K (286.6 kg ha<sup>-1</sup>). Over the other treatments, a single basal application of organic matrix entrapped biofertilizers II increased the amount of soluble K (Ashok *et al.*, 2014).

Patel *et al.* (2015) examined the effect of continuous cropping on soil characteristics and nutrient budgets both with and without FYM. The crop productivity was negatively impacted by the application of only nitrogen and phosphorus fertilizers, which had a mining effect on the potassium and micronutrient reserves and reduced their availability.

After rice was harvested, the slow-release N fertilizers had a considerable impact on the soil's potassium availability. The amount of available potassium in the soil was found to be much greater (409 kg ha<sup>-1</sup>) in the treatment 125 percent neem coated urea (NCU). This was followed by the amounts of available potassium (406 kg

ha<sup>-1</sup>) seen in the treatment 100 percent NCU. In absolute control, the lowest potassium concentration (388 kg ha<sup>-1</sup>) was discovered Khandey *et al.* (2017).

The application of urea blended with 85% N through Agro-N-protect resulted in the maximum soil accessible potassium (410.5 kg ha<sup>-1</sup>) and was comparable to treatments using 85% N-GRDF through Agro-N-protect urea + neem coated urea and 85% N-GRDF - neem coated urea (387.6 kg ha<sup>-1</sup>). The presence of NH<sub>4</sub><sup>+</sup> ions in the soil prevented potassium from being fixed and enhanced potassium availability in the soil at the time of maize crop harvest crop (Kumar *et al.*, 2017).

#### **2.6.4 Available sulphur**

In New Zealand, alternative S fertilizers were researched. They claimed that bentonite clay and powdered sulphur granules produced SO<sub>4</sub>-S more gradually. Second, the bentonite addition increased the material's conductivity and decreased losses Boswell *et al.* (1986).

Boswell *et al.* (1986) assessed the availability of S in soil using sulphur bentonite. The findings showed that the amount of accessible sulphur rose when bentonite was raised from 5% to 40% in the prills. A good rate of S delivery to plants was found to be possible using bentonite clay at a concentration of 10%. Due to the time it took for the prill to disintegrate, bentonite S's oxidation progressed more slowly than elemental S.

On Vertisols, the reaction of soybean to various sulphur fertilizer doses and sources was investigated. Ammonium sulphate (AS), elemental sulphur (ES), and complex fertilizer were the sources used to apply sulphur in four amounts (0, 10, 20, and 30 kg ha<sup>-1</sup>) (13-33-0-15S). When soybeans were harvested, there was a noticeably greater amount of accessible S in the soil when sulphur doses and sources were used in comparison to the control treatment. The complex fertilizer (13-33-0-15S) had the maximum available sulphur (8.80 kg ha<sup>-1</sup>), whereas the control treatment had the lowest value (7.82 kg ha<sup>-1</sup>) (Sharma *et al.*, 2004).

In the rice-wheat cropping sequence, the impact of various sulphur sources on the soil's accessible sulphur was investigated. Gypsum and phosphogypsum were combined at a rate of 30, 60 kg per hectare, and control (no sulphur) was given to the rice crop. Three levels of elemental sulphur 0, 15 and 30 kg per hectare were administered to the wheat crop. The results showed that applying gypsum at 30 and

60 kilogramme of sulphur per hectare and phosphogypsum at 30 and 60 kg of sulphur per hectare, respectively, enhanced the soil's sulphur status after two years of cropping systems by 6.4, 12.7, 5.2, and 9.7 percent (Ram *et al.*, 2017).

## **2.7 Effect of different coated fertilizers on DTPA extractable soil micronutrient**

According to the findings, applying phosphogypsum and gypsum at rates of 30 and 60 kilogrammes of sulphur per hectare and 30 and 60 kilogrammes of sulphur per hectare, respectively, increased the soil's sulphur status by 6.4, 12.7, 5.2, and 9.7 percent after two years of crop systems (Cui *et al.*, 2004).

The impact of organic manures and mineral fertilizers on soil nutrient availability in the pearl millet-wheat cropping sequence was investigated in a field experiment. Only nitrogenous and phosphatic fertilizer treatments were found to have the lowest DTPA extractable Fe, Mn, Zn, and Cu content. When organic manures were administered instead of no manure, a noticeable increase in DTPA extractable Fe, Mn, Zn, and Cu was seen (Antil and Singh, 2007).

The results of integrated FYM and inorganic fertilizer management were investigated. The 50 percent nitrogen, phosphorous, and potassium crop requirement was met in part by the integration of crop leftovers, FYM, or green manure, as well as those elements. Soil organic carbon increased as a result of the application of organic manures. In comparison to inorganic fertilizers alone, the use of organic amendments and chemical fertilizers considerably boosted the availability of nitrogen, phosphorous, potassium, sulphur, and micronutrients in soil (Kumar *et al.*, 2008).

N, P, K, and cationic micronutrient availability in the soil as well as the impact of integrated nutrient management were investigated. The integrated nutrient management technique aided in improving the soil's nutritional status with regard to N, P, K, Fe, Mn, Cu, and Zn. In the treatments receiving organic manure at 4 t ha<sup>-1</sup> + Zn-EDTA 0.5 kg ha<sup>-1</sup> and organic manure at 10 t ha<sup>-1</sup>, the level of cationic micronutrients (Fe, Mn, Cu, and Zn) in the soil rose (Sur *et al.*, 2010).

In high pH soils, the impact of sulphur fertilisation on micronutrient availability was studied. Sulfur was added to the soil at a rate of 0.5 g S kg<sup>-1</sup>, which resulted in a pH value decrease from background levels of 7.03 to 6.29 and considerably higher manganese and zinc availability of 0.38 and 0.91 percent, respectively. The findings showed that applying sulphur to soil at doses of 0.5 and 1 g

kg<sup>-1</sup> increased manganese availability by 0.38 and 1.40 percent, respectively (Karimizarchi *et al.*, 2014).

The effects of applying fertilizer and manure on the availability of soil micronutrients were investigated. It was noted that the starting value of 3.6 mg kg for DTPA extractable Cu in soil held true across all treatments (Kundu *et al.*, 2016).

Following the harvest of the maize crop, nitrogen fertilizers (70 and 85 percent RD-N) in combination with nitrogen inhibitors (Agroh N Protect urea and neem coated urea) considerably boosted the soil's available micronutrients. Nitrogen fertilizers (70 and 85 percent RD-N) in combination with nitrogen inhibitors (Agroh N Protect urea and neem coated urea) significantly increased the soil's accessible micronutrients after the maize crop was harvested (Kumar *et al.*, 2017).

The general recommended dose of fertilizers (GRDF) (200:40:200 N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O g + 10 kg FYM plant<sup>-1</sup>) and nitrogen application through crotonylidenediurea had a substantial impact on the residual soil accessible micronutrients, specifically iron, manganese, copper, and zinc. GRDF and 100% nitrogen through crotonylidenediurea had statistically equivalent manganese (12.13 and 12.28 g g<sup>-1</sup> soil) and zinc (0.70 and 0.70 g g<sup>-1</sup> soil) contents, but 100% nitrogen through crotonylidenediurea had significantly greater copper content (3.06 g g<sup>-1</sup> soil). The treatment that included a 25 percent nitrogen application through crotonylidenediurea (4.70 g g<sup>-1</sup> soil) had the greatest accessible iron levels Pawar *et al.* (2017).

On soil micronutrients, the impact of integrated nutrient management was investigated. The findings showed that adding chemical fertilizers and manures to the soil boosted the soil's availability of micronutrients. The soil's micronutrient content was dramatically boosted by applying FYM @ 10 t ha<sup>-1</sup> + 100% RDF (Prashanth *et al.*, 2019).

To evaluate the influence of fertilizer type on micronutrients over time, a field experiment was carried out. According to the findings, micronutrient reductions were slowed down by FYM and inorganic N treatment, indicating that these two practises together could slow down the deterioration of micronutrients over time (Shiwakoti *et al.*, 2019).

## **2.8 Effect of coated fertilizer on nutrient use efficiency in bt cotton crop.**

### **2.8.1 Partial factor productivity**

Tesfay and Grimay. (2019) investigated combinations of N, K, and S for partial factor productivity in onions (*Allium Cepa* L.). Significant variations in growth, yield, and partial factor productivity of N, K, and S were seen as a result of the combined application of nutrient levels for N, K, and S. The treated plots that did not receive any applications of N or K nutrients had the highest partial factor productivity (PFP).

The response of wheat to slow-release nitrogen fertilizers was studied. The experiment consisted of N doses (130, 117, 104, and 94 kg ha<sup>-1</sup>). The results show that, the positive effect of coated fertilizers was found on growth, development, physiological, yield and PFP (Ghafoor *et al.*, 2021).

### **2.8.2 Agronomic efficiency**

The effectiveness of N, K, and S nutrient mixtures in growing onions (*Allium cepa* L.) was investigated. The field experiment used a completely randomised block design to combine three levels of N and K with two levels of S. With the application of substantially higher NKS nutrient levels, improved bulb output and improved nutrient use efficiencies (agronomic use efficiency) were discovered (Tesfay and Grimay 2019).

Application deep placement of urea fertilizer (DMU) containing 1 % (w/w) of the nitrification inhibitor 3,4-dimethylpyrazole phosphate (DMPP) increased N use efficiency in soybean crop and decreased the nitrate leaching to underground and river (Hatano *et al.*, 2019).

### **2.8.3 Apparent nutrient recovery**

In comparison to other sources of S, such as gypsum or SSP, the apparent sulphur recovery (ASR) with gromor bentonite S pastille at 20 kg S ha<sup>-1</sup> was higher. Gypsum and SSP are inferior to gromor bentonite S pastille; this could be because of the latter's high concentration, minimal leaching loss, and gradual release pattern (Jena and Kabi 2012).

Agronomic efficiency and agronomic recovery efficiency of P was increased with decreasing the rates of polymer coated DAP fertilizers. The application of 50%

of the recommended rate of polymer coated DAP fertilizer compared to uncoated DAP fertilizer showed the greatest increases in P agronomic efficiency (112%) and recovery efficiency (172%) Recovery efficiency (130%) obtained in polymer coated DAP at 100% rate of recommendation over uncoated DAP application came next, followed by recovery efficiency (159%) reported in polymer coated DAP at 75% rate of recommendation (Noor *et al.*, 2017).

## **2.8 Effect of different coated fertilizers on economics of different crops.**

A field experiment was carried out to investigate how Indian mustard's economics were impacted by organic matrix-based slow-release fertilizers. Given that they were based on local agro-waste products, the formulations used were economical. The cost of growing Indian mustard revealed that slow-release fertilizer with an organic matrix (SRF-II) provided the highest net financial returns, at (+) 56,578/- ha<sup>-1</sup>, and that slow-release fertilizer alone produced net financial returns of Rs. 51,784/- ha<sup>-1</sup> (SRF-I). Absolute control had the lowest net returns (Rs. 36,160/- ha<sup>-1</sup>). The conventional fertilizer treatment's net financial returns were Rs. 49,612/- ha<sup>-1</sup>. As a result, these slow-release formulations were affordable for Indian mustard's sustainable yield (Sharma and Singh 2011).

Over a wide range of soil conditions and crops, Avail® polymer has demonstrated beneficial benefits on the availability and uptake of fertilizer P. The monoammonium phosphate Avail® polymer coating enhanced the availability of phosphorus, which results in higher increased crop quality and yields. This method increased farmer earnings in addition to agricultural production. Potato (cv. US No. 1) yields increased by 14%, and gross returns increased by \$494 per hectare thanks to the coated monoammonium phosphate. The quality of the potato explained half of the enhanced return (Sanders *et al.*, 2012).

The cost of the sulphur needed to coat the prilled urea ranged from 6.28 percent for urea coated with just 1% sulphur to 31.43 percent for urea coated with 5% sulphur. Costs for sulphur-coating prilled urea per hectare for 130 kg N ha<sup>-1</sup> ranged from US \$ 3.42 for 1 percent SCU to US \$ 10.15 for 5 percent SCU. Compared to the other treatments, 4 percent sulphur-coated urea had better net returns, and no other treatments showed any improvement. 5 percent sulphur coated urea was found to have

a considerable boost in net returns. However, a 5 percent S coating on prilled urea was reported with a considerably high benefit:cost ratio (Shivay *et al.*, 2016).

In terms of economic returns, neem coated urea was found to have a significantly greater effect on soybeans than regular urea. Due to the use of NCU in soybeans, a total cost of Rs. 1,140/acre<sup>-1</sup> was added under a distinct subhead. But gross profits over standard urea were observed to be Rs. 2,545/- acre<sup>-1</sup>, and the B: C ratio in NCU was 2.23 (Niranjan *et al.*, 2017).

Due to its reduced cost compared to coated urea (CU) and lime nitrogen, it was determined that urea fertilizer containing 1% 3,4-dimethylpyrazole phosphate DMPP is effective for deep placement of N fertilizer for soybean growth (LN) (Hatano *et al.*, 2019).

**CHAPTER -III**  
**MATERIAL AND METHODS**

## CHAPTER-III

### MATERIAL AND METHODS

Field experiments on cotton were conducted in *Kharif* 2021-22 at Research Farm of Department of Soil Science and Agril. Chemistry, Vasantrya Naik Marathwada Krishi Vidyapeeth, Parbhani on Vertisols. The experiments on cotton were conducted to study the “Studies on Efficacy of Coated Fertilizer on Soil Properties, Yield and Quality of Bt Cotton”.

The details of materials used, experimentation and analytical techniques adopted for this investigation are presented in this chapter in following sequence.

#### 3.1 Location and climate

Parbhani is situated at 409 m above mean sea level between 19°18' north latitude and 75°47' East longitude in Marathwada division of Maharashtra semi-arid climate. Parbhani is grouped under assured rainfall zone. The average rainfall of the district is 1336.70 mm with 42 rainy days. The mean daily maximum temperature varied from 20.80°C in December to 33.40°C in July. The variation in rainfall distribution, temperature and atmospheric humidity recorded during the experimental period.

#### 3.2 Experimental soils

The soil of experimental site of the present investigation was classified as Vertisol soil order belonging to Parbhani soil series which comprise of fine Montmorillonite isohyperthermic family of Typic Haplusterts (Malewar, 1976). The soils were dominant in Montmorillonite mineral followed by moderate amount of Kaolinite type of mineral and traces of Illite mineral. The soils of the region come under Deccan trap and developed on basaltic rock, which is inherently rich in lime, iron and magnesium (Gajbe *et al.*, 1976). The soils of Parbhani series constitute bulk of iron ores along with chlorite, tourmaline, hornblend, epidote, feldspar, quartz, augite, pyrite, muscovite and pyroxenes (Maniyar *et al.*, 1981). The soils of parbhani district belongs to Parbhani series (Typic Haplusterts), on the basis of morphology, soil depth ad texture (Zade *et al.*, 2017).

The physico-chemical properties of experimental soil are presented in Table 3.1. The soil was very deep black (depth-110 cm) having swell shrink property. The

texture of the soil was clayey. The soil was alkaline in reaction (pH 8.28), low in salt content ( $0.20 \text{ dS m}^{-1}$ ) with high calcium carbonate content ( $10 \text{ g kg}^{-1}$ ). The organic carbon status of the soil was medium ( $6.6 \text{ g ha}^{-1}$ ). The soil available nitrogen was low ( $172.48 \text{ kg ha}^{-1}$ ), available phosphorus was medium ( $9.11 \text{ kg ha}^{-1}$ ), available potassium was very high ( $705.6 \text{ kg ha}^{-1}$ ) and available sulphur was medium ( $20.55 \text{ mg kg}^{-1}$ ). The DTPA extractable soil micronutrients were also analysed and data presented in (Table 3.1).

**Table 3.1: Initial properties of experimental soil.**

Sr. No.	Soil Properties	Values
1	Bulk density ( $\text{Mg m}^3$ )	1.39
2	Soil Reaction (pH)	8.28
3	Electrical conductivity ( $\text{dSm}^{-1}$ )	0.20
4	Organic Carbon ( $\text{g kg}^{-1}$ )	6.6
5	Calcium Carbonate ( $\text{g kg}^{-1}$ )	10
6	Available Nitrogen ( $\text{kg ha}^{-1}$ )	172.48
7	Available Phosphorus ( $\text{kg ha}^{-1}$ )	9.11
8	Available potassium ( $\text{kg ha}^{-1}$ )	705.60
9	Available sulphur ( $\text{mg kg}^{-1}$ )	20.55
10	Available micronutrients	
I	Available Zinc ( $\text{mg kg}^{-1}$ )	0.49
II	Available Iron ( $\text{mg kg}^{-1}$ )	2.84
III	Available Manganese ( $\text{mg kg}^{-1}$ )	7.90
IV	Available Copper ( $\text{mg kg}^{-1}$ )	2.14

### 3.2.1 Experimental Details

Field experiment was conducted on “**Studies on efficacy of coated fertilizer on soil properties, yield and quality of Bt cotton**” during *Kharif* 2021 and 2022. Experiment consisted of nine treatments in which recommended dose of NPK was given as per treatments.



**Plate. 3.1 General View of Experimental Plot.**

1.	Design of experiment	:	RBD
2.	Year of start	:	2021
3.	Season	:	<i>Kharif</i>
4.	Crop	:	Cotton
5.	Variety	:	Ajeet 155 BG II
6.	Replications	:	Three
7.	Treatments	:	9
8.	Total No. of plots	:	27
9.	Plot size	:	7.2 m × 4.8 m
10.	Row to row spacing	:	90 cm
11.	Plant to plant spacing	:	60 cm
12.	No. of rows per plot	:	8
13.	No. of Plants per rows	:	8
11.	Method of sowing	:	Dibbling
12.	Recommended dose of fertilizes	:	120:60:60 NPK Kg ha <sup>-1</sup>
13.	Date of Sowing	:	29 June 2021
			11 November 2021 (1 <sup>st</sup> Picking)
14.	Date of picking	:	20 November 2021 (2 <sup>nd</sup> Picking)
			13 December 2021 (3 <sup>rd</sup> Picking)
15.	Date of uprooting	:	30 December 2021
16.	No. of irrigation	:	Rainfed

### 3.2.2. Experimental layout

The experiment was laid out in Randomized Block Design (RBD) with ten treatments and three replications. The layout of experiment is presented in (Fig.1).

### 3.2.3 Plan of Layout – (Fig.3.1)

**Table 3.3: Treatment details for field experiment**

<b>Tr. No.</b>	<b>Treatment Details</b>
1	Absolute control
2	Recommended dose of fertilizer (Through straight fertilizer)
3	RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)
4	RDF through non coated fertilizer grade (N: P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)
5	25% reduction to RDF with coated fertilizer grade
6	25% reduction to RDF with non-coated fertilizer
7	50% reduction to RDF with coated fertilizer
8	50% reduction to RDF with non-coated fertilizer
9	RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only

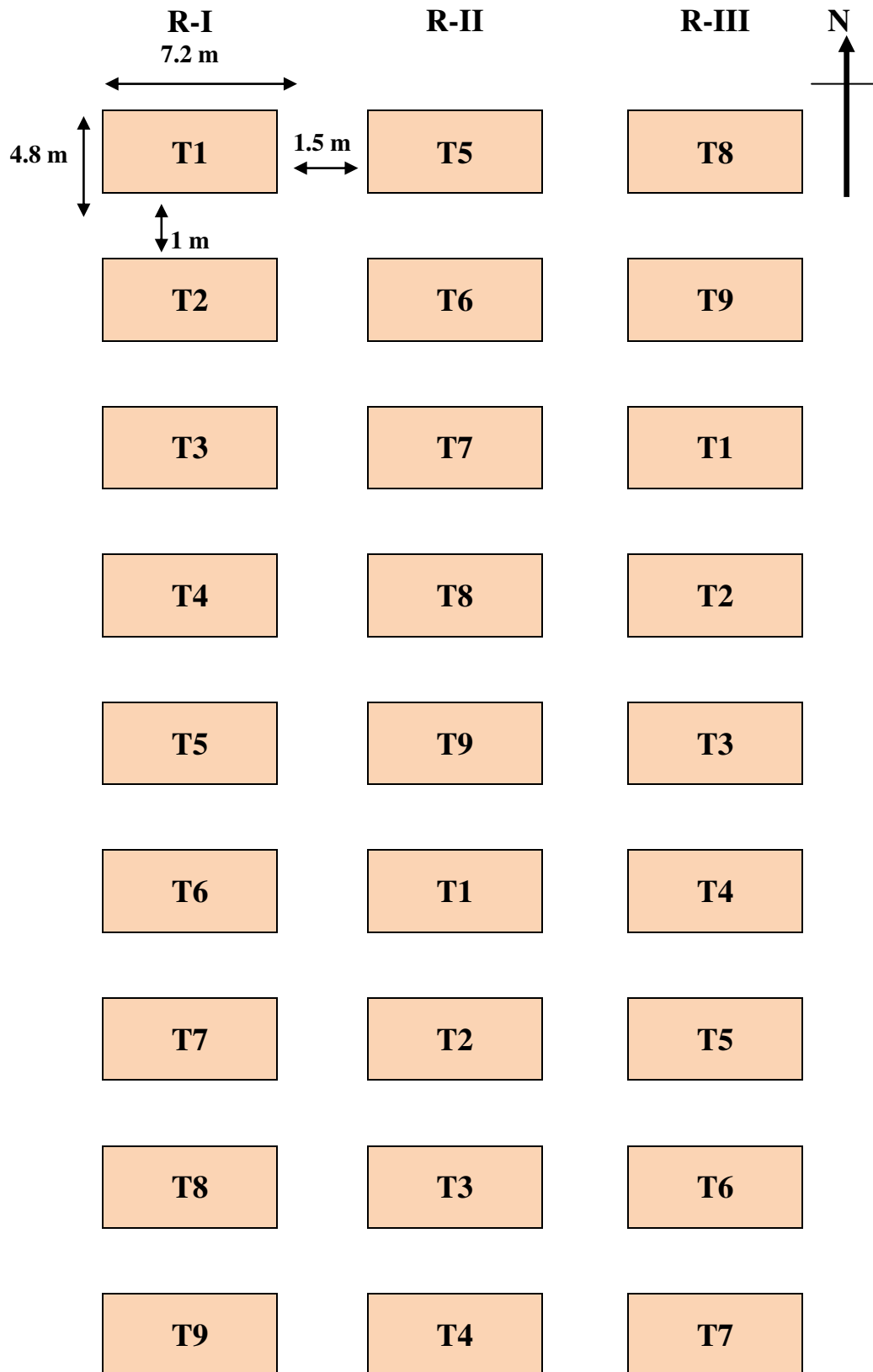
### **3.4 Inputs for the experiments**

#### **3.4.1 Seeds and sowing**

The certified seed of cotton (Ajeet 155 BG II) were sown in *Kharif* by dibbling two seeds per hill. Thus, one hundred twenty-four seeds were dibbled in each plot.

#### **3.4.2 Fertilizer application**

The basal dose of nitrogen, phosphorus and potassium were applied in soil at the time of sowing. Nitrogen was applied in three splits 50% at the time of sowing and 25% after 30 days of sowing and remaining 25% after 60 days of sowing.



**Fig. 3.1 : Plan of Layout**



**Coated fertilizergrade N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)**



**Straight Fertilizer (Urea, Single Super Phosphate, Muriate of Potash)**

**Plate. 3.2 Fertilizers used for experiment.**



**T2 - Recommended dose of fertilizer  
(Through straight fertilizer)**



**T3- RDF through coated fertilizer  
grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B  
11:23:10:4:1.9:0.4:0.2)**



**T4- RDF through non-coated fertilizer  
grade(N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B  
11:23:10:4:1.9:0.4:0.2)**



**T7 - 50% reduction to RDF with  
coated fertilizer**

**Plate 3.3 Influence of different fertilizer treatment on bt cotton in field  
experiment.**

**Table 3.4: Composition of Fertilizer**

Coated Grade	11:23:10
Regular grade	22:0:20
RDF	N through Urea P through SSP K through MOP

### **3.4.3 Cultural operation**

Cultural operation *viz.*, gap filling and thinning were done and plant population maintained. Periodical operation such as weeding and hoeing were carried out to maintain the experimental plot free from weed as per recommendation.

### **3.5 Biometric observations**

#### **3.5.1 Plant population at germination and at harvest**

Emergence count at 11 days was recorded by counting number of hills per net plot and their representative percentage were transformed and recorded. Final plant stand was noted by counting the number of hills per net plot at 170 days after sowing and the respective percentage were transformed and recorded.

#### **3.5.2 Plant height**

The main stem height was measured in centimetre from ground level to the base of the last fully opened leaf at the apex of the five observation plants in each net plot at 30,60 90 days after sowing and at harvest and average was worked out.

#### **3.5.3 Number of monopodial branches per plant.**

The total number of monopodia at 30 and 60 days after sowing was counted from five observational plants from each net plot and by dividing the total number by five an average number of monopodial branches per plant were worked out

#### **3.5.4 Number of sympodial branches per plant.**

Total number of fruiting branches was taken from five observational plants and an average number of sympodial branches per plant were worked out by dividing the total number by five the count was taken at 60, 90, 120 DAS and at harvest.

### **3.5.5 Days to 50% flowering**

This was recorded by observing the plot every day when 50% plants opened flowers in this observation, days required for 50% flowering was recorded at Bowering stage and required days were calculated

### **3.5.6 SPAD chlorophyll meter reading at physiological maturity**

By observing best growing three leaves from a plant and considering five plants in each net plot chlorophyll content was by using SPAD chlorophyll meter recorded at 20, 40, 60, 80 and 100 days after sowing and average was worked out.

### **3.5.7 Number of bolls per plant**

The total number of balls per plant from five observational plants were counted at 60, 90 and 120 days after sowing and dividing it by five an average number of balls per plant was calculated and noted.

### **3.5.8 Mean boll weight (gm)**

At time of second picking seed cotton from five well opened representative bolls from each plant were picked and average bolls weight in (g) were recorded on each plant.

### **3.5.9 Dry matter accumulation.**

The weight of dry matter accumulated in plant is an index of the plant growth. The roots of the plant uprooted for dry matter study, were removed and after removing the roots the plant were air dried under sun for eight days and subsequently dried in the thermostatic oven at 65 +2°C, till they were completely dried. The final constant dry weight was recorded as total dry matter weight in gram per plant.

### **3.5.10 Seed cotton yield per plant (gm)**

Each plant under observation was picked separately and produce obtained from good locules of three picking contributed to the seed cotton yield per plant.

### **3.5.11 Seed cotton yield per plot per hectare (kg/ha)**

Seed cotton from each net plot was picked and weighed separately at each picking. The total yield for net plot was worked out by adding the quantities of seed cotton picked in all the pickings along with the total yield obtained from five

observation plants to get total seed cotton yield from each plot, which was subsequently converted to seed cotton yield per hectare.

### **3.6 Quality parameter and Economics**

#### **3.6.1 Ginning percentage**

The ginning percentage is the weight of lint divided by the weight of seed cotton represented as a percentage. Each plant's produce was bulked individually, and a clean representative sample was taken (*i.e.*, 200g) from each treatment. The seed cotton was machine ginned, and the weight of the lint and seed cotton was recorded.

The ginning % was estimated using the formula below.

$$\text{Ginning (\%)} = \frac{\text{Weight of lint (g)}}{\text{Weight of total seed cotton}} \times 100$$

#### **3.6.2 Seed index/ Test weight**

Seed index was calculated by weighing 100 seeds of each plot per replication and averaged.

#### **3.6.3 Lint index**

The weight of lint (g) obtained from 100 individual seed from each plot was considered as lint index. Lint index was calculated by using following formula.

$$\text{L.I} = \frac{\text{Weight of 100 seed} \times \text{Ginning \%}}{100 - \text{Ginning \%}}$$

#### **3.6.4 Staple cotton length**

The lint present on seed was combed keeping it on seed as it is and halo length was read at point on three radicle lines marked on standard halo disk in mm and mean halo length was estimated.

#### **3.6.5 Cost of cultivation**

Cost of cultivation was calculated by addition of all the cost incurred towards purchasing of inputs, cost incurring towards mechanical operations and the cost

incurred as labor charges Treatment wise cost of cultivation was worked out and recorded by considering the inputs and implements used.

### **3.6.6 Gross monetary returns**

Seed cotton yield and stalk yield of cotton hybrid were converted into money values (Rs ha<sup>-1</sup>) at the prevailing market price.

### **3.6.7 Net monetary returns**

Net monetary returns were calculated by subtracting the cost of cultivation from gross monetary returns.

### **3.6.10 Benefit cost ratio**

It is the ratio of gross monetary returns to the cost of cultivation, which can also be expressed as returns per rupee invested. It is also called input output ratio and calculated by following formula.

$$\text{Benefit cost ratio} = \frac{\text{Gross monetary return (Rs ha}^{-1}\text{)}}{\text{Cost of cultivation (Rs ha}^{-1}\text{)}}$$

## **3.7 Soil analysis**

The soil samples were collected from each plot at various growth stages and at harvest of the crop from surface layer (0-15 cm) of each plot of the layout. Soils were air dried, ground with wooden mortar and pestle and passed through 2 mm sieve. The sieved samples were stored in polythene bags with proper labeling for further analysis. These soil samples were subjected to various chemical estimations as per standard methods.

### **3.7.1 Soil reaction (pH)**

It was determined in (1:2.5) soil water suspension using digital pH meter (Jackson, 1973).

### **3.7.2 Electrical conductivity**

It was determined in (1:2.5) soil water suspension by using conductivity meter (Jackson, 1973).

### **3.7.3 Organic carbon**

Organic carbon was determined by Walkely and Black (1934) titration method as described by Jackson (1973).

### **3.4.4 Calcium carbonate**

Calcium carbonate was determined by rapid titration method as suggested by (Piper, 1966).

### **3.7.5 Available nitrogen**

Available nitrogen was determined by alkaline permanganate method as described by Subbiash and Asija (1956).

### **3.7.6 Available phosphorous**

Available phosphorous was extracted from the soil with 0.5 M sod bicarbonate at pH 8.5 and thus extracted P was determined by Olsen's method (Olsen *et al.*, 1954).

### **3.7.7 Available potassium**

Available potassium was determined by using neutral normal ammonium acetate as an extractant by using flame photometer (Jackson, 1973).

### **3.7.8 Available sulphur**

It was determined by using turbidimetry method and measured on spectrophotometer as described by Chopra and Kanwar (1976).

### **3.7.9 DTPA micronutrient**

The available Fe, Mn, Zn and Ca were determined by using DTPA extractant on Atomic Absorption Spectrophotometer (AAS) as described by Lindsay and Norvell (1978).

## **3.8 Plant analysis**

Plant samples (seed and straw) were collected, cleaned with deionised water and dried in sample process room and subsequently in oven at 65°C until constant weight and grinded well to maximum fineness. The processed plant samples from field and pot culture experiment were used for analysis of nutrients and quality parameters by using standard methods of plant analysis.

### **3.8.1 Digestion of plant samples**

Fine powdered plant sample (0.5 gram) was taken in 100 ml conical flask. 5 ml of concentrated nitric acid was added to it and kept for overnight. On next day, 10 ml of diacid mixture ( $\text{HNO}_3$  and  $\text{HClO}_4$ , 9:4) was added and digested on hot plate as described by Piper (1966). After digestion, known volume was prepared with glass distilled water. The same extract was used for estimation of sulphur content.

### **3.8.2 Nitrogen determination**

The nitrogen content in plant samples was determined by Microkjeldhal method as described in A.O.A.C (2012). 0.5 gram of plant sample was digested with 1-gram  $\text{K}_2\text{SO}_4$ , 0.5 gm  $\text{CuSO}_4 \cdot \text{H}_2\text{O}$  and 25 ml. concentrated  $\text{H}_2\text{SO}_4$  and the digested plant sample was then distilled with  $\text{NaOH}$ . The distillate was collected in a beaker containing 4 % boric acid in presence of methyl red and bromocresol green mixed indicator. The contents were back titrated with 0.1 N sulphuric acid until light pink colour was obtained.

### **3.8.3 Phosphorus determination**

The digest prepared with diacid mixture was used for determination of phosphorus. The phosphorus was estimated by Vanadomolybdo phosphoric acid yellow colour method with spectrophotometer as given by Jackson (1973). The intensity of yellow colour was measured on spectrophotometer using 420 nm wavelengths.

### **3.8.4 Potassium determination**

The diacid extract was used for potassium determination. It was determined with flame photometer as described by Jackson (1973).

### **3.8.5 Sulphur determination**

It was estimated from diacid digested sample by turbidimetric method as described by Tabatabai and Bremner (1970).

### 3.8.6 Micronutrients (Zn, Fe, Mn and Cu)

The Zn, Fe, Mn and Cu content in plant was determined from the extract obtained from digestion of plant samples with HNO<sub>3</sub> and HClO<sub>4</sub> using Atomic Absorption Spectrophotometer, as described by Lindsay and Norvell (1978).

### 3.8.7 Uptake of nutrients

The uptake of major and micronutrients were worked out by multiplying dry matter accumulation to N, P, K, Fe, Mn, Zn and Cu concentration at harvest by using the following formula.

$$\text{Uptake of nutrient (kg ha}^{-1}\text{)} = \frac{\text{Total dry matter (kg ha}^{-1}\text{)} \times \text{Concentration of element (\%)}}{100}$$

### 3.9 Nutrient use efficiency

The nutrient use efficiency for nitrogen, phosphorus and potassium in cotton field experiment was calculated by using different nutrient use efficiency measures *viz.*, partial factor productivity, agronomic efficiency and apparent nutrient recovery. The details are as below.

**Partial Factor productivity (PFP)**- It was calculated in units of crop yield per unit of nutrient applied by using following formula (Fixen *et al.*, 2014).

$$\text{PFP} = \frac{\text{Economic yield (Kg ha}^{-1}\text{)} + \text{Biological yield (Kg ha}^{-1}\text{)}}{\text{Nutrient applied (Kg ha}^{-1}\text{)}}$$

**Agronomic efficiency (AE)** – It was calculated by considering the yield of fertilized plot, yield in control plot and quantity of fertilizer applied by using the following formula (Baligar *et al.*, 2001).

$$\text{AE (Kg ha}^{-1}\text{)} = \frac{\text{Yield of fertilized plot (Kg ha}^{-1}\text{)} - \text{Yield of control plot (Kg ha}^{-1}\text{)}}{\text{Quantity of nutrient applied (Kg ha}^{-1}\text{)}}$$

**Apparent nutrient recovery (ANR)** – It was calculated by using the nutrient uptake in control and fertilized plot and quantity of nutrient applied (Baligar *et al.*, 2001).

$$\text{ANR (\%)} = \frac{\text{Nutrient uptake (in fertilized plot – in control plot) (Kg ha}^{-1}\text{)}}{\text{Quantity of nutrient applied (Kg ha}^{-1}\text{)}} \times 100$$

### 3.10 Economics of cotton cultivation

Economics of cotton cultivation was calculated as per following formulae.

#### 3.10.1 Gross monetary returns

The selling price of cotton were considered as per MSP given by Government of India and used for calculation of gross monetary returns. The treatment wise gross monetary returns were worked out by multiplying economic yield ( $q \text{ ha}^{-1}$ ) by market prices ( $\text{Rs } q^{-1}$ ).

$$\text{GMR} = \text{Economic yield (q ha}^{-1}\text{)} \times \text{Selling price/ market prices (Rs q}^{-1}\text{)}.$$

#### 3.10.2 Net monetary returns

The treatment wise net monetary returns were worked out by subtracting treatment wise cost of cultivation from treatment wise gross monetary returns as per formula given below.

$$\text{NMR} = \text{GMR (Rs ha}^{-1}\text{)} - \text{Cost of cultivation (Rs ha}^{-1}\text{)}.$$

#### 3.10.3 Benefit: cost ratio

The treatment wise B:C ratio worked out by dividing treatment wise gross monetary returns with the treatment wise cost of cultivation.

$$\text{B: C ratio} = \frac{\text{Gross monetary returns (Rs ha}^{-1}\text{)}}{\text{Cost of cultivation (Rs ha}^{-1}\text{)}}$$

### 3.11 Statistical analysis

Results obtained were statistically analyzed as per the method described by Panse and Sukhatme (1985). Approximate standard error (SE) was worked out and critical differences at 5% level were given whenever necessary for interpretation.

**CHAPTER -IV**  
**RESULTS AND DISCUSSION**

## **CHAPTER - IV**

### **RESULT AND DISCUSSION**

In order to evaluate the effect of coated fertilizer on soil properties, yield and quality of Bt cotton. Field experiment was conducted during 2021-22 at research farm, Department of soil science and agricultural chemistry, Vasantrya Naik Marathwada Krishi Vidyapeeth Parbhani, with nine treatment and three replications.

The data available from this study was complicated and further subjected to statistical analysis. The relevant data is tabulated and results obtained are presented and discussed in this chapter under the following sub heads.

#### **4.1 Effect of coated fertilizer on growth parameter of Bt cotton.**

4.1.1 Plant population at germination and at harvest

4.1.2 Plant height

4.1.3 Number of monopodial branches

4.1.4 Number of sympodial branches

4.1.5 Days to 50 % flowering

4.1.6 Soil plant analysis development values

#### **4.2 Effect of coated fertilizer on yield parameter of Bt cotton.**

4.2.1 Number of bolls per plant

4.2.2 Mean boll weight

4.2.3 Dry matter yield

4.2.4 Seed cotton yield

#### **4.3 Effect of coated fertilizer on quality parameter of Bt cotton.**

4.3.1 Ginning percentage

4.3.2 Lint index

4.3.3 Staple length

4.3.4 Seed index

#### **4.4 Effect of coated fertilizer on Physico-Chemical properties of soil under Bt cotton.**

- 4.4.1 Soil pH
- 4.4.2 Electrical conductivity
- 4.4.3 Organic carbon content
- 4.4.4 Calcium carbonate content

#### **4.5 Effect of coated fertilizer on nutrient availability in soil under Bt cotton.**

- 4.5.1 Available nitrogen
- 4.5.2 Available phosphorus
- 4.5.3 Available potassium
- 4.5.4 Available sulphur
- 4.5.5 DTPA extractable iron
- 4.5.6 DTPA extractable manganese
- 4.5.7 DTPA extractable copper
- 4.5.8 DTPA extractable Zinc

#### **4.6 Effect of coated fertilizer on nutrient content in Bt cotton after harvest of crop.**

- 4.6.1 Nitrogen concentration in seed and straw
- 4.6.2 Phosphorus concentration in seed and straw
- 4.6.3 Potassium concentration in seed and straw
- 4.6.4 Sulphur concentration in seed and straw
- 4.6.5 Iron concentration in seed and straw
- 4.6.6 Manganese concentration in seed and straw
- 4.6.7 Copper concentration in seed and straw
- 4.6.8 Zinc concentration in seed and straw

#### **4.7 Effect of coated fertilizer on nutrient uptake by Bt cotton after harvest of crop.**

4.7.1 Nitrogen uptake in Bt cotton

4.7.2 Phosphorus uptake in Bt cotton

4.7.3 Potassium uptake in Bt cotton

4.7.4 Sulphur uptake in Bt cotton

4.7.5 Iron uptake in Bt cotton

4.7.6 Manganese uptake in Bt cotton

4.7.7 Copper uptake in Bt cotton

4.7.8 Zinc uptake in Bt cotton

#### **4.8 Effect of coated fertilizer on nutrient use efficiency in Bt cotton crop.**

#### **4.9 Effect of coated fertilizer on economics of Bt cotton.**

#### **4.1 Effect of coated fertilizer on growth parameter of Bt cotton.**

The fertilizer management through coated fertilizers had significant impact on growth attributes, *viz.*, plant population at germination and at harvest, plant height, number of monopodial and sympodial branches, days to 50% flowering, chlorophyll content of bt cotton during the year of experimentation.

##### **4.1.1 Plant population at germination and at harvest**

The data presented in (Table 4.1) shows that the plant population per plot at germination of cotton was varied from 63 to 63.67. Result on germination statistically was found to be non-significant. The plant population per plot is maintained by gap filling at harvest. Result on plant population at harvest was found non-significant.

**Table 4.1: Effect of coated fertilizer on plant population at germination and at harvest of Bt cotton.**

Treatments	Plant population plot <sup>-1</sup>	
	At germination	At harvest
T <sub>1</sub> - Absolute control	63.00	64.00
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	63.33	64.00
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	63.67	64.00
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	63.33	64.00
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	63.33	64.00
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	62.33	64.00
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	63.33	64.00
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	63.00	64.00
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	63.00	64.00
<b>SE m±</b>	<b>0.53</b>	<b>0</b>
<b>CD at 5 %</b>	<b>NS</b>	<b>-</b>
<b>CV</b>	<b>1.48</b>	<b>0</b>

#### 4.1.2 Plant height

Coated fertilizers provided a superior nutritional environment for cotton during the crop growth period, which improved root growth and subsequently boosted plant height and crop growth rate. The data on plant height of cotton at various growth stages influenced by coated fertilizer during the year of experimentation are presented in Table 4.2. It revealed that the plant height at 30 DAS, 60 DAS, 90 DAS and at harvest was varied from 17.17 to 23.77 cm, 37.81 to 49.97 cm, 72.30 to 90.35 cm, 115.05 to 132.69 cm, respectively. Significantly maximum height was recorded in treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) followed by (T<sub>5</sub>), (T<sub>7</sub>). However, minimum plant height was recorded in (T<sub>1</sub>) *i.e.*, Absolute control at all

stages. Our results are similar to findings of Noor *et al.* (2017), they found that the application of complete recommended dose of through polymer-coated DAP raised wheat plant height by 13.4% over control and by 4.1 above DAP that wasn't coated. In comparison to the control treatment using various rates of polymer coated DAP increased plant height.

**Table 4.2: Effect of coated of fertilizer on plant height of Bt cotton.**

Treatments	Height of plant (cm)			
	30 DAS	60 DAS	90 DAS	After harvest
T <sub>1</sub> - Absolute control	17.17	37.81	72.30	115.05
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	18.92	40.56	78.48	120.66
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	23.77	49.97	90.35	132.69
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	17.40	43.61	82.74	125.33
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	19.81	47.00	85.97	129.90
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	16.53	42.07	80.05	123.99
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	17.17	43.12	81.49	124.25
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	19.63	38.72	77.58	121.01
T <sub>9</sub> – RDF through straight/ complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	19.70	41.63	81.72	121.84
<b>SE m±</b>	<b>0.61</b>	<b>0.33</b>	<b>0.48</b>	<b>0.54</b>
<b>CD at 5 %</b>	<b>1.84</b>	<b>1.01</b>	<b>1.45</b>	<b>1.64</b>
<b>CV</b>	<b>5.64</b>	<b>1.38</b>	<b>1.04</b>	<b>0.77</b>

### 4.1.3 Number of monopodial branches

Monopodials are not important and non-significant for yield of seed cotton. The data on monopodial branches of cotton at various growth stages influenced by coated fertilizer during the year of experimentation are presented in Table 4.3. It revealed that the monopodial branches at 30 DAS, 60 DAS, was varied from 1.57 to 3.02 and 12.43 to 4.18 respectively.

**Table 4.3: Effect of coated fertilizer on number of monopodial branches plant<sup>-1</sup> of Bt cotton.**

Treatments	Number of monopodial branches plant <sup>-1</sup>	
	30 DAS	60 DAS
T <sub>1</sub> - Absolute control	1.57	2.43
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	2.61	3.00
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	3.02	4.18
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	2.75	3.67
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	2.83	3.88
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	2.48	3.53
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	2.67	3.56
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	2.42	3.37
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	2.61	3.29
<b>SE m±</b>	<b>0.15</b>	<b>0.06</b>
<b>CD at 5 %</b>	<b>0.45</b>	<b>0.19</b>
<b>CV</b>	<b>10.36</b>	<b>3.30</b>

Significantly maximum monopodial branches was recorded in treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) followed by (T<sub>5</sub>), (T<sub>7</sub>). However, minimum number of monopodial branches was recorded in (T<sub>1</sub>) *i.e.*, Absolute control

at all stages. Our results are similar to Begum *et al.* (2015), they noticed that, combined application of 25 kg N with 54 kg P per ha through inorganic fertilizers the results was the highest number of branches observed in crop.

#### 4.1.4 Number of sympodial branches

The data on sympodial branches of cotton at various growth stages influenced by coated fertilizer during the year of experimentation are presented in Table 4.4 and Fig 4.1. It shows that the sympodial branches at 30 DAS, 60 DAS, 90 DAS was varied from 4.15 to 8.15, 12.62 to 16.74 and 14.43 to 23.86 respectively.

**Table 4.4: Effect of coated fertilizer on number of sympodial branches plant<sup>-1</sup> of Bt cotton.**

Treatments	Number of sympodial branches plant <sup>-1</sup>		
	30 DAS	60 DAS	90 DAS
T <sub>1</sub> - Absolute control	4.15	12.62	14.43
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	5.25	13.41	17.95
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	8.15	16.74	23.86
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	7.90	15.05	19.89
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	8.00	16.02	21.40
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	7.75	14.82	17.92
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	7.70	15.23	18.91
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	7.54	13.55	16.92
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	5.60	13.60	18.42
<b>SE m±</b>	<b>0.16</b>	<b>0.65</b>	<b>0.52</b>
<b>CD at 5 %</b>	<b>0.49</b>	<b>1.96</b>	<b>1.56</b>
<b>CV</b>	<b>4.12</b>	<b>7.80</b>	<b>4.80</b>

Significantly maximum sympodial branches was recorded in treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade

(N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) followed by (T<sub>5</sub>), (T<sub>7</sub>). However, minimum number of sympodial branches was recorded in (T<sub>1</sub>) *i.e.*, Absolute control at all stages. Our results are similar to Begum *et al.* (2015), they noticed that, combined application of 25 kg N with 54 kg P per ha through inorganic fertilizers the results was the highest number of branches observed in crop.

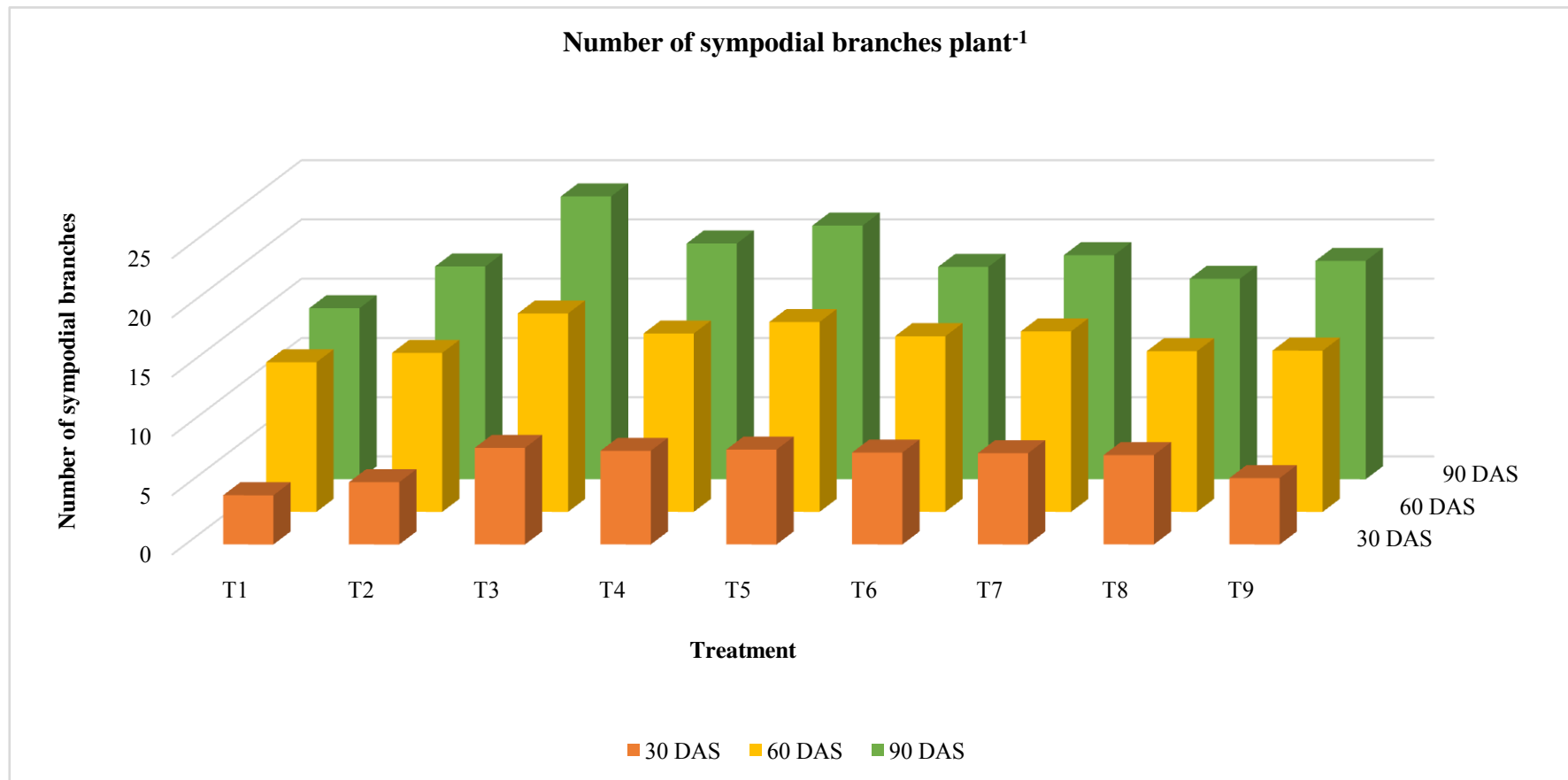
#### 4.1.5 Days to 50 % flowering

The application of coated fertilizer affects the number of days to 50 % flowering in bt cotton. The data noticed in Table 4.5 shows that the days to 50 % flowering of cotton was varied from 63.15 to 70.00.

**Table 4.5: Effect of coated fertilizer on days to 50% flowering of Bt cotton.**

Treatments	Days to 50% flowering
T <sub>1</sub> - Absolute control	70.00
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	66.85
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	63.15
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	69.81
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	65.82
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	70.44
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	66.26
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	71.10
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	67.12
<b>SE m±</b>	<b>0.54</b>
<b>CD at 5 %</b>	<b>1.64</b>
<b>CV</b>	<b>1.40</b>

Significantly minimum days required to 50 % flowering was recorded in treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) followed by (T<sub>5</sub>), (T<sub>7</sub>). However, maximum days required to 50 % flowering was recorded in (T<sub>1</sub>) *i.e.*, Absolute control. Our experimental results are to in corroborating with the findings of Yasir *et al.* (2015), they reported that the nutritional effects on nitrogen and sulphur



**Fig. 4.1 Effect of coated fertilizer on number of sympodial branches plant<sup>-1</sup>.**

on the number of maturity days were investigated. The treatments receiving only N had highest number of days to maturity.

#### **4.1.6 Soil Plant Analysis Development values**

The nutrient that frequently restricts crop productivity is nitrogen (N), and adding nitrogen to the soil to meet crop needs is the most expensive and time-consuming task. Monitoring crop N status is preferred so that management adjustments can be made to maximise yield and quality due to the harmful effects of limited or excess N on cotton (*Gossypium hirsutum* L.).

There is relationship between SAPD values and N content in plant. The data on SPAD values of cotton at various growth stages influenced by coated fertilizer during the year of experimentation are represented in Table 4.6 and Fig 4.2 it noticed that the SPAD values at 20 DAS, 40 DAS, 60 DAS, 80 DAS and 100 DAS of cotton was varied from 30.60 to 39.79, 30.95 to 39.73, 30.86 to 39.86, 21.33 to 39.69 and 21.75 to 38.84, respectively.

Significantly maximum SPAD values was recorded in treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) followed by (T<sub>5</sub>), (T<sub>7</sub>). However, minimum SPAD values was recorded in (T<sub>1</sub>) *i.e.*, Absolute control at all stages.

Our results are similar to findings of Geng *et al.* (2016) who reported that the SPAD values were considerably affected by N and S fertilization. Under PCU fertilization treatment, the SPAD value were higher compared with urea treatment.

**Table 4.6: Effect of coated fertilizer on soil plant analysis development values of Bt cotton.**

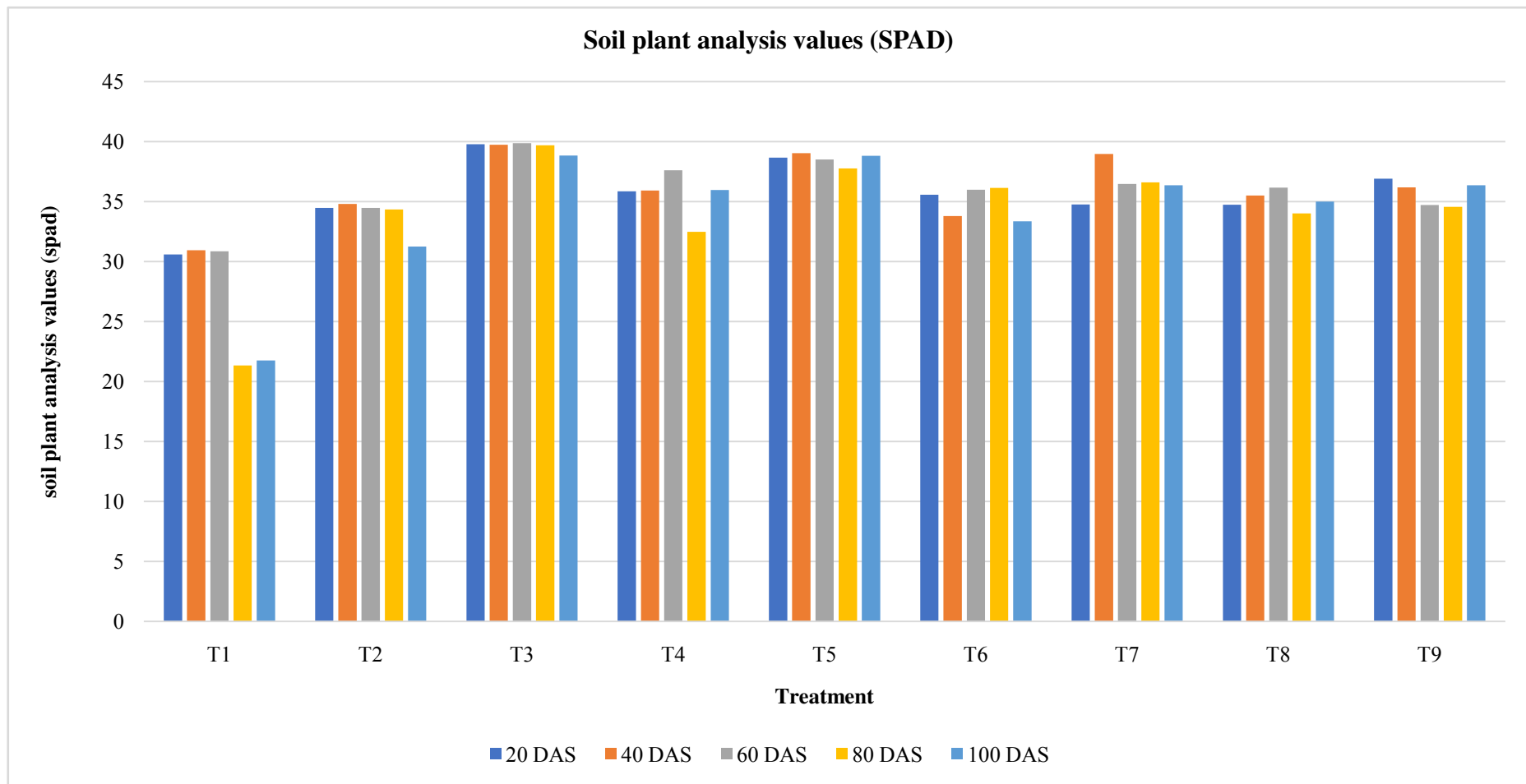
Treatments	Soil Plant Analysis Development values (SPAD)				
	20 DAS	40 DAS	60 DAS	80 DAS	100 DAS
T <sub>1</sub> - Absolute control	30.60	30.95	30.86	21.33	21.75
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	34.48	34.81	34.48	34.35	31.25
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	39.79	39.73	39.86	39.69	38.84
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	35.86	35.93	37.61	32.47	35.97
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	38.66	39.04	38.51	37.77	38.82
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	35.56	33.79	35.98	36.13	33.36
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	34.76	38.97	36.46	36.59	36.35
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	34.74	35.50	36.17	34.02	35.01
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	36.91	36.19	34.71	34.57	36.35
<b>SE m±</b>	<b>0.67</b>	<b>0.62</b>	<b>1.05</b>	<b>3.03</b>	<b>0.70</b>
<b>CD at 5 %</b>	<b>2.02</b>	<b>1.87</b>	<b>3.17</b>	<b>9.10</b>	<b>2.11</b>
<b>CV</b>	<b>3.28</b>	<b>3.01</b>	<b>5.08</b>	<b>15.43</b>	<b>3.48</b>

#### 4.2 Effect of coated fertilizer on yield parameter of Bt cotton.

The data related to yield parameter of Bt cotton as influenced by coated fertilizer are presented below.

##### 4.2.1 Number of bolls per plant

The number of bolls per plant is an essential yield parameter as it provides a prediction of the probable yield. The data on number of bolls plant<sup>-1</sup> in cotton at



**Fig. 4.2 Effect of coated fertilizer on soil plant analysis development values (SPAD).**

various growth stages influenced by coated fertilizer during the year of experimentation are presented in Table 4.7.

**Table 4.7: Effect of coated fertilizer on number of bolls plant<sup>-1</sup> of Bt cotton.**

Treatments	Number of bolls plant <sup>-1</sup>		
	30 DAS	60 DAS	90 DAS
T <sub>1</sub> - Absolute control	18.10	23.37	26.73
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	20.25	25.97	29.15
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	24.30	30.03	33.84
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	22.43	28.57	31.97
T <sub>5</sub> - 25% reduction to RDF with coated fertilizer grade	23.21	28.77	31.78
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	21.84	26.77	31.37
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	21.72	27.52	31.23
T <sub>8</sub> - 50% reduction to RDF with non-coated fertilizer	21.10	24.80	30.57
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	21.44	26.57	29.78
<b>SE m±</b>	<b>0.37</b>	<b>0.76</b>	<b>0.83</b>
<b>CD at 5 %</b>	<b>1.12</b>	<b>2.28</b>	<b>2.49</b>
<b>CV</b>	<b>3.01</b>	<b>4.90</b>	<b>4.69</b>

It observed that the number of bolls plant<sup>-1</sup> 60 DAS, 90 DAS, and 120 DAS of cotton was varied 53.10 to 74.30, 58.37 to 80.03 and 61.73 to 86.84, respectively.

Significantly maximum number of bolls plant<sup>-1</sup> was recorded in treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) followed by (T<sub>5</sub>), (T<sub>7</sub>). However, minimum number of bolls plant<sup>-1</sup> was recorded in (T<sub>1</sub>) *i.e.*, Absolute control at 60 DAS, 90 DAS, and 120 DAS of cotton. Hosamani *et al.* (2013), reported that increased in seed cotton yield with 125 percent RDF might be due to significantly

higher number of good opened boll plant<sup>-1</sup>, total number of bolls harvested plant<sup>-1</sup>, mean boll weight, amount of dry matter accumulation in reproductive parts of and leaf area upto harvest.

#### 4.2.2 Mean boll weight

The data pertaining on effect of coated fertilizer on mean boll weight is represented in Table 4.8.

**Table 4.8: Effect of coated fertilizer on mean boll weight plant<sup>-1</sup> of Bt cotton.**

Treatments	Mean boll weight plant <sup>-1</sup> (g)
T <sub>1</sub> - Absolute control	2.70
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	2.89
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	3.62
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	3.17
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	3.22
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	3.06
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	3.16
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	2.83
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	3.12
<b>SE m±</b>	<b>0.07</b>
<b>CD at 5 %</b>	<b>0.22</b>
<b>CV</b>	<b>4.29</b>

It shows that the mean boll weight of cotton ranged from 2.70 to 3.62 (g). Significantly maximum mean boll weight of cotton *i.e.*, 3.62 g was recorded in treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) followed by (T<sub>5</sub>), receiving 25% reduction to RDF (120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer grade 3.22 g, (T<sub>7</sub>), receiving 50% reduction to RDF(120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer 3.16 g. However, minimum number of bolls per plant was recorded in (T<sub>1</sub>) *i.e.*, Absolute control 2.70 g. Hosamani *et al.* (2013), reported that increased in seed cotton yield with 125 percent RDF might be due to significantly higher number of good

opened boll per plant, total number of bolls harvested per plant, mean boll weight, amount of dry matter accumulation in reproductive parts of and leaf area upto harvest.

#### 4.2.3 Dry matter yield

The impact of coated fertilizer on cotton produced a higher biological yield and improved cotton plant growth and development. The data on effect of coated fertilizer on dry matter yield of cotton is presented in Table 4.9. It shows that the on dry matter yield of cotton ranged from 2407.40 to 2887.73 (kg/ha).

Significantly maximum dry matter yield of cotton *i.e.*, 2887.73 kg/ha was recorded in treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) followed by (T<sub>5</sub>), receiving 25% reduction to RDF (120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer grade 2791.67kg/ha, (T<sub>7</sub>), receiving 50% reduction to RDF(120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer 2641.67 kg/ha .

However, minimum dry matter yield of cotton was recorded in (T<sub>1</sub>) *i.e.*, Absolute control 2407.40. Hosamani *et al.* (2013) reported that increased in seed cotton yield with 125 percent RDF might be due to significantly higher number of good opened boll per plant, total number of bolls harvested per plant, mean boll weight, amount of dry matter accumulation in reproductive parts of and leaf area upto harvest.

**Table 4.9: Effect of coated fertilizer on dry matter yield of Bt cotton.**

Treatments	Dry matter yield (kg ha <sup>-1</sup> )
T <sub>1</sub> - Absolute control	2407.40
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	2592.59
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	2887.73
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	2648.58
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	2791.67
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	2603.33
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	2641.67
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	2740.16
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	2610.67
<b>SE m±</b>	<b>25.07</b>
<b>CD at 5 %</b>	<b>75.16</b>
<b>CV</b>	<b>1.63</b>

#### 4.2.4 Seed cotton yield

The data on seed cotton yield per plant (kg) as influenced by different treatment are given in Table 4.10 and Fig 4.3 the result revealed that the seed cotton yield per plant varied in the range of 1.83 to 5.76 (kg).

Significantly seed cotton yield per plant of cotton *i.e.*, 5.76 (kg) was recorded in treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) followed by (T<sub>5</sub>), receiving 25% reduction to RDF (120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer grade 4.98 kg, (T<sub>7</sub>), receiving 50% reduction to RDF (120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer 3.50kg. However, minimum seed cotton yield per plant of cotton was recorded in (T<sub>1</sub>) *i.e.*, Absolute control 1.83 kg.

**Table 4.10: Effect of coated fertilizer on seed cotton yield plant<sup>-1</sup> of Bt cotton.**

<b>Treatments</b>	<b>Seed cotton yield plant<sup>-1</sup> (kg)</b>
<b>T<sub>1</sub></b> - Absolute control	1.83
<b>T<sub>2</sub></b> - Recommended dose of fertilizer (Through straight fertilizer)	2.98
<b>T<sub>3</sub></b> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	5.76
<b>T<sub>4</sub></b> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	4.71
<b>T<sub>5</sub></b> -25% reduction to RDF with coated fertilizer grade	4.98
<b>T<sub>6</sub></b> - 25% reduction to RDF with non-coated fertilizer	4.04
<b>T<sub>7</sub></b> - 50% reduction to RDF with coated fertilizer	3.50
<b>T<sub>8</sub></b> -50% reduction to RDF with non-coated fertilizer	3.02
<b>T<sub>9</sub></b> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	3.77
<b>SE m±</b>	<b>0.44</b>
<b>CD at 5 %</b>	<b>1.32</b>
<b>CV</b>	<b>19.96</b>

The data on seed cotton yield ( $q\ ha^{-1}$ ) as influenced by different treatment are given in Table 4.11. The result revealed that the seed cotton yield varied in the range of 532.00 to 1667.00 ( $Kg\ ha^{-1}$ ). Significantly seed cotton yield ( $q\ ha^{-1}$ ) of cotton *i.e.*, 1667.00 kg/ha was recorded in treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) followed by (T<sub>5</sub>), receiving 25% reduction to RDF (120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer grade 1443.00 Kg ha<sup>-1</sup>, T<sub>7</sub> receiving 50% reduction to RDF (120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer 1015.00 Kg ha<sup>-1</sup>. However, minimum seed cotton yield ( $q\ ha^{-1}$ ) of cotton was recorded in (T<sub>1</sub>) *i.e.*, Absolute control 532.00 kg/ha. Hosamani *et al.* (2013) reported that increased in seed cotton yield with 125 percent RDF might be due to significantly higher number of good opened boll per

plant, total number of bolls harvested per plant, mean boll weight, amount of dry matter accumulation in reproductive parts of and leaf area upto harvest.

**Table 4.11: Effect of coated fertilizer on seed cotton yield of Bt cotton.**

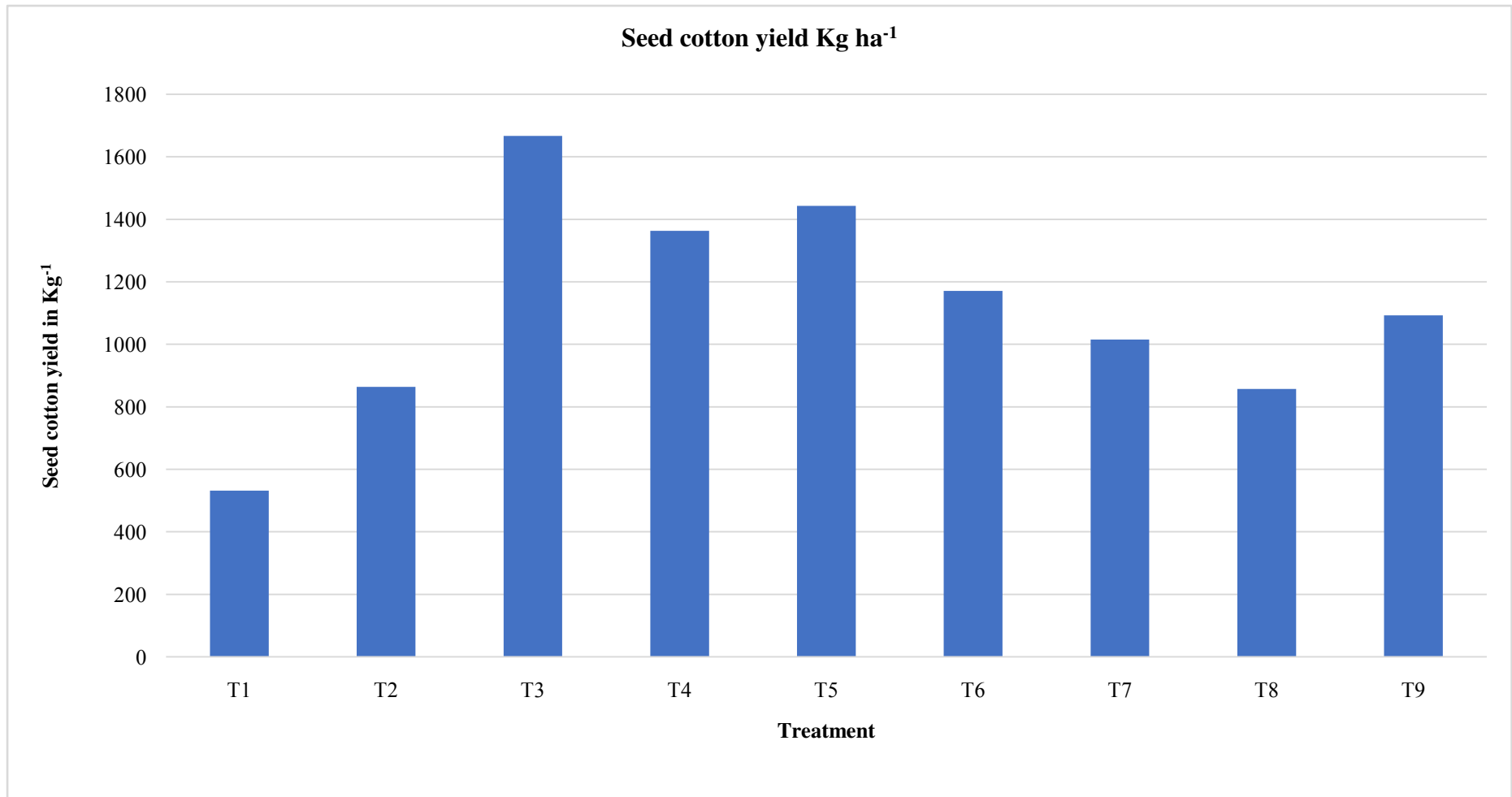
Treatments	Seed cotton yield (Kg ha <sup>-1</sup> )
T <sub>1</sub> - Absolute control	532.00
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	864.00
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	1667.00
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	1363.00
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	1443.00
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	1171.00
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	1015.00
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	857.00
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	1093.00
<b>SE m±</b>	<b>2.69</b>
<b>CD at 5 %</b>	<b>8.09</b>
<b>CV</b>	<b>0.42</b>

#### 4.3 Effect of coated fertilizer on quality parameter of Bt cotton.

The data pertaining to quality parameter of Bt cotton as influenced by coated fertilizer are presented in Table 12.

##### 4.3.1 Ginning percentage

The data on ginning percentage as influenced by different treatment are given in Table 4.12 and Fig 4.4. The result revealed that the ginning percentage varied in the range of 35.53 to 40.80. Significantly ginning percentage of cotton *i.e.*, 40.80 was recorded in treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) followed by (T<sub>5</sub>), receiving 25% reduction to RDF (120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer grade 40.50, (T<sub>7</sub>), receiving 50% reduction to RDF(120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer 39.00. However, minimum ginning percentage of cotton was recorded in (T<sub>1</sub>) *i.e.*, Absolute control 35.53.



**Fig. 4.3 Effect of coated fertilizer on seed cotton yield of Bt cotton.**

### 4.3.2 Lint index

The data on lint index as influenced by different treatment are given in (Table 4.12 and Fig 4.4) it revealed that the lint index varied in the range of 3.63 to 5.93. Significantly lint index of cotton *i.e.*, 5.93 was recorded in treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) followed by (T<sub>5</sub>), receiving 25% reduction to RDF (120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer grade 5.29, (T<sub>7</sub>), receiving 50% reduction to RDF (120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer 5.26. However, minimum lint index of cotton was recorded in (T<sub>1</sub>) *i.e.*, Absolute control 3.63 The data on lint index of cotton was found statistically non-significant. Fertilization with coated fertilizer doses and there application did not match the lint index significantly during study.

### 4.3.3 Staple length

The data on staple length (mm) as influenced by different treatment are given Table 4.12 and Fig 4.4. The result shows that the staple length (mm) varied in the range of 25.40 to 26.60.

Significantly staple length (mm) of cotton *i.e.*, 26.60 (mm) was recorded in treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) followed by (T<sub>5</sub>), receiving 25% reduction to RDF (120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer grade 26.40 (mm) , (T<sub>7</sub>), receiving 50% reduction to RDF(120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer 26.30 (mm).

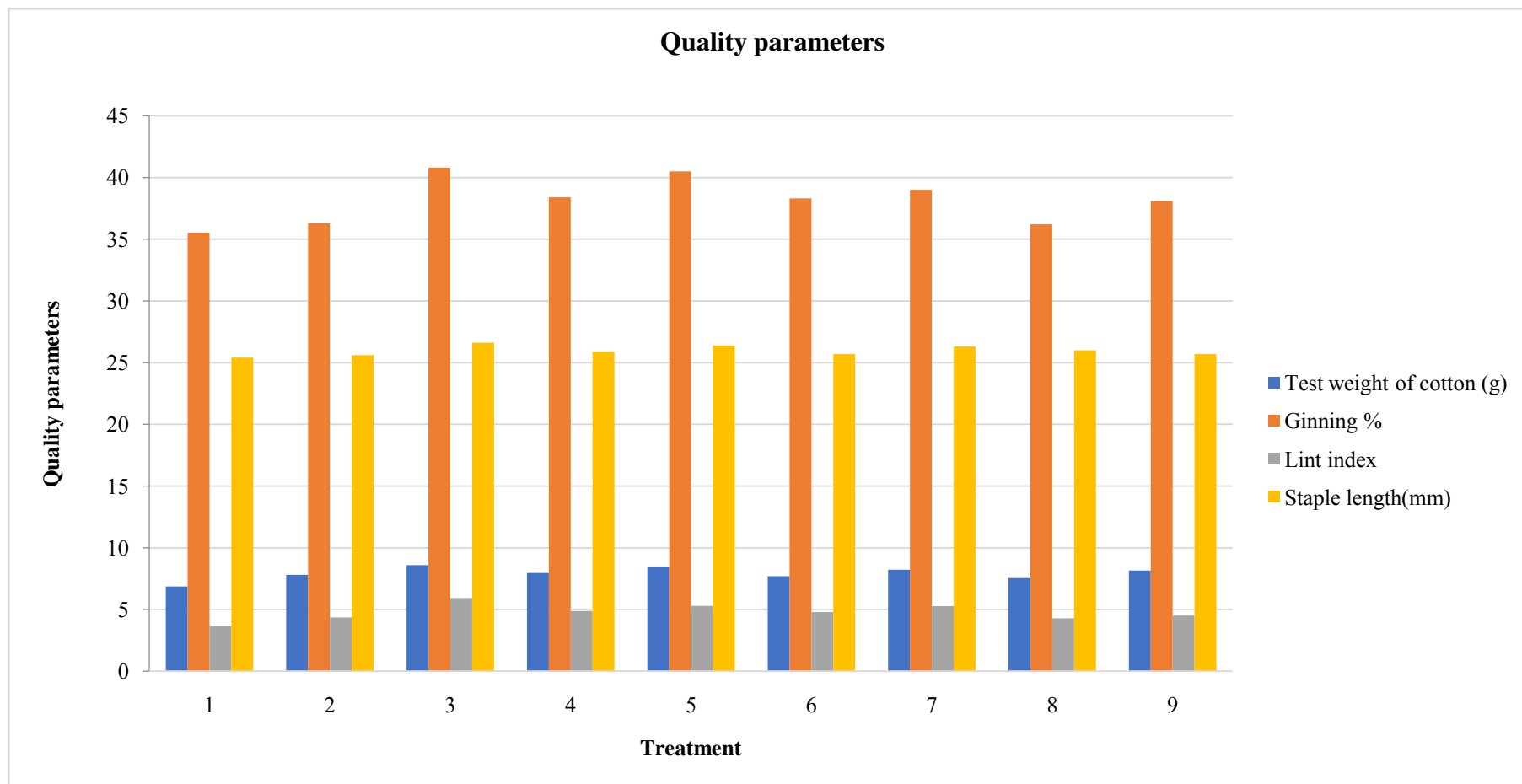
However, minimum lint index of cotton was recorded in (T<sub>1</sub>) *i.e.*, Absolute control 25.40 (mm). The data on staple length (mm) of cotton was found statistically non-significant. Fertilization with coated fertilizer doses and there application did not match the staple length significantly during study.

**Table 4.12: Effect of coated fertilizer on ginning percentage, lint index, staple length of Bt cotton.**

Treatments	Ginning %	Lint index	Staple length(mm)
T <sub>1</sub> - Absolute control	35.53	3.63	25.40
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	36.30	4.36	25.60
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	40.80	5.93	26.60
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	38.40	4.87	25.90
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	40.50	5.29	26.40
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	38.30	4.78	25.70
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	39.00	5.26	26.30
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	36.20	4.29	26.00
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	38.10	4.51	25.70
<b>SE m±</b>	<b>0.23</b>	<b>0.60</b>	<b>0.25</b>
<b>CD at 5 %</b>	<b>0.71</b>	<b>NS</b>	<b>NS</b>
<b>CV</b>	<b>1.08</b>	<b>22.10</b>	<b>1.70</b>

#### 4.3.4 Seed index

The data on effect of coated fertilizer on seed index of cotton is presented in Table 4.13. It revealed that the on-seed index of cotton ranged from 6.87 to 8.60 (g). Significantly maximum seed index of cotton *i.e.*, 8.60 (g) was recorded in treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) followed by (T<sub>5</sub>), receiving 25% reduction to RDF (120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer grade 8.48 (g), (T<sub>7</sub>),



**Fig. 4.4 Effect of coated fertilizer on Quality parameter of Bt cotton**

receiving 50% reduction to RDF(120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer 8.23 (g). However, minimum seed index of cotton was recorded in (T<sub>1</sub>) *i.e.*, Absolute control 6.87 (g). Our results are related to findings of Ali *et al.* (2017), who reported that the application with 50% and 100% doses of polymer coated DAP increased the test weight of wheat by 2% and 16% respectively.

**Table 4.13: Effect of coated fertilizer on seed index of Bt cotton.**

<b>Treatments</b>	<b>Seed index of cotton (g)</b>
<b>T<sub>1</sub></b> - Absolute control	6.87
<b>T<sub>2</sub></b> - Recommended dose of fertilizer (Through straight fertilizer)	7.80
<b>T<sub>3</sub></b> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	8.60
<b>T<sub>4</sub></b> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	7.95
<b>T<sub>5</sub></b> -25% reduction to RDF with coated fertilizer grade	8.48
<b>T<sub>6</sub></b> - 25% reduction to RDF with non-coated fertilizer	7.70
<b>T<sub>7</sub></b> - 50% reduction to RDF with coated fertilizer	8.23
<b>T<sub>8</sub></b> -50% reduction to RDF with non-coated fertilizer	7.54
<b>T<sub>9</sub></b> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	8.15
<b>SE m±</b>	<b>0.23</b>
<b>CD at 5 %</b>	<b>0.71</b>
<b>CV</b>	<b>5.24</b>

#### **4.4 Effect of coated fertilizer on Physico-Chemical properties of soil under Bt cotton.**

##### **4.4.1 Soil pH**

The effect of coated fertilizer on soil pH was found non-significant in Bt cotton. The data pertaining to soil pH as influenced by application of coated fertilizer to Bt cotton are presented in Table 4.14. Soil pH is basic property which generally does not alter easily in Vertisol and associated black soil due to more buffering capacity. The initial soil pH was 8.28.

Recorded data on pH observed that the soil reaction was not much influenced significantly due to application of coated fertilizer. Jia *et al.* (2021) investigated It was

investigated how applying biochar-coated urea affected the characteristics of the soil. Eight treatment combinations made up of two nitrogen fertilizer suppliers, two nitrogen fertilisation rates, and biochar made up the experiment. The results showed that soil pH was higher in control treatment (6.17) than in urea treatments (U1- 5.95, U2- 5.89), as well as in urea treatments with biochar coating (BCU1- 6.10, BCU2- 6.03). Between the control, Urea1 + biochar, and Urea2 + biochar, there was no discernible difference in soil pH.

#### **4.4.2 Electrical conductivity**

The results on electrical conductivity as influenced by coated fertilizer are shown in Table 4.14. Electrical conductivity indicates total soluble salts in the soil solution. The initial electrical conductivity was  $0.20 \text{ dsm}^{-1}$ . There was slight variation in the electrical conductivity due to application of coated fertilizer. The electrical conductivity of soil ranged from 0.20 to 0.30 at harvesting stage of Bt cotton. The electrical conductivity was found statistically non-significant. Higher electrical conductivity was recorded in treatment ( $T_3$ ), receiving RDF (120:60:60 Kg NPK  $\text{ha}^{-1}$ ) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)  $0.30 \text{ dsm}^{-1}$  followed by ( $T_5$ ), receiving 25% reduction to RDF (120:60:60 Kg NPK  $\text{ha}^{-1}$ ) with coated fertilizer grade  $0.23 \text{ dsm}^{-1}$ , ( $T_7$ ) receiving 50% reduction to RDF (120:60:60 Kg NPK  $\text{ha}^{-1}$ ) with coated fertilizer  $0.22 \text{ dsm}^{-1}$ . However, minimum electrical conductivity of cotton was recorded in ( $T_1$ ) *i.e.*, Absolute control  $0.26 \text{ dsm}^{-1}$

Our results are related to findings of Khandey *et al.* (2017) who reported that the electrical conductivity which measures the total soluble salt concentration, was found to be highest in 125 % NCU (3 split) compared to 100 % NCU (2 split).

#### **4.4.3 Organic carbon**

The data on organic carbon of soil at harvesting stage of Bt cotton as affected by coated fertilizer are presented in Table 4.14. Organic carbon in soil clearly indicates that there was decrease in organic carbon over initial values due to application of coated fertilizer over absolute control. Higher organic carbon was recorded in treatment ( $T_3$ ), receiving RDF (120:60:60 Kg NPK  $\text{ha}^{-1}$ ) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)  $5.6 \text{ g kg}^{-1}$  followed by ( $T_5$ ), receiving 25% reduction to RDF (120:60:60 Kg NPK  $\text{ha}^{-1}$ ) with coated fertilizer grade  $4.9 \text{ g kg}^{-1}$ , ( $T_7$ ) receiving 50% reduction to RDF (120:60:60 Kg NPK

ha<sup>-1</sup>) with coated fertilizer 4.3 g kg<sup>-1</sup>. However, minimum organic carbon of cotton was recorded in (T<sub>1</sub>) *i.e.*, Absolute control 3.2 g kg<sup>-1</sup>. The organic carbon was found statistically non significant.

Our results are corresponds with the findings of Khandey *et al.* (2017) they observed that the soil organic carbon was found higher in the treatment 125 % NCU (3 split) at 30 days after transplanting.

#### **4.4.4 Calcium Carbonate content**

The effect of coated fertilizer on calcium carbonate content in soil at harvest stage of Bt cotton are presented in Table 4.14. The calcium carbonate content in soil was 7.00 to 8.58 % at harvesting stage of Bt cotton. The calcium carbonate content was influenced significantly due to the application of coated fertilizer. Higher calcium carbonate content was recorded in treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) 8.58 % followed by (T<sub>5</sub>), receiving 25% reduction to RDF (120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer grade 7.9 %, (T<sub>7</sub>) receiving 50% reduction to RDF (120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer 7.33 % . However, minimum calcium carbonate content of cotton was recorded in (T<sub>1</sub>) *i.e.*, Absolute control 7.25 %. Our experimental results are to in corroborating with the findings of Yaseen *et al.* (2017), they observed that the application of polymer coated diammonium phosphate fertilizer enhanced the physical, chemical and microbiological characteristics of soil.

**Table 4.14: Effect of coated fertilizer on Physico-Chemical properties of soil under Bt cotton.**

<b>Treatments</b>	<b>pH (1:2.5)</b>	<b>EC (dSm<sup>-1</sup>)</b>	<b>Organic Carbon (g kg<sup>-1</sup>)</b>	<b>Calcium Carbonate (g kg<sup>-1</sup>)</b>
<b>T<sub>1</sub></b> - Absolute control	7.93	0.26	3.23	6.37
<b>T<sub>2</sub></b> - Recommended dose of fertilizer (Through straight fertilizer)	7.77	0.20	4.37	8.17
<b>T<sub>3</sub></b> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	7.77	0.31	5.63	8.58
<b>T<sub>4</sub></b> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	7.90	0.22	4.83	7.17
<b>T<sub>5</sub></b> -25% reduction to RDF with coated fertilizer grade	7.83	0.23	4.97	7.92
<b>T<sub>6</sub></b> - 25% reduction to RDF with non- coated fertilizer	7.87	0.27	4.97	7.08
<b>T<sub>7</sub></b> - 50% reduction to RDF with coated fertilizer	7.73	0.23	4.37	7.33
<b>T<sub>8</sub></b> -50% reduction to RDF with non- coated fertilizer	7.87	0.22	3.93	7.00
<b>T<sub>9</sub></b> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	8.27	0.21	4.07	7.25
<b>SE m±</b>	<b>0.11</b>	<b>0.03</b>	<b>0.53</b>	<b>0.31</b>
<b>CD at 5 %</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>	<b>0.9327</b>
<b>CV</b>	<b>2.60</b>	<b>22.77</b>	<b>20.62</b>	<b>7.25</b>

#### **4.5 Effect of coated fertilizer on nutrient availability in soil under Bt cotton.**

##### **4.5.1 Available nitrogen**

The data pertaining to soil available nitrogen at harvest of Bt cotton showed significant results due to coated fertilizer treatments (Table 4.15 and Fig 4.5). The initial available nitrogen in soil was 172.48 kg ha<sup>-1</sup>. It was found that availability of nitrogen varied from 173.78 to 216.38 kg ha<sup>-1</sup>.

**Table 4.15: Effect of coated fertilizer on available nitrogen in soil after harvest of Bt cotton.**

<b>Treatments</b>	<b>Available Nitrogen (Kg ha<sup>-1</sup>)</b>
<b>T<sub>1</sub></b> - Absolute control	173.78
<b>T<sub>2</sub></b> - Recommended dose of fertilizer (Through straight fertilizer)	187.10
<b>T<sub>3</sub></b> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	216.38
<b>T<sub>4</sub></b> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	195.45
<b>T<sub>5</sub></b> -25% reduction to RDF with coated fertilizer grade	205.94
<b>T<sub>6</sub></b> - 25% reduction to RDF with non-coated fertilizer	190.25
<b>T<sub>7</sub></b> - 50% reduction to RDF with coated fertilizer	201.75
<b>T<sub>8</sub></b> -50% reduction to RDF with non-coated fertilizer	187.11
<b>T<sub>9</sub></b> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	202.78
<b>SE m±</b>	<b>5.74</b>
<b>CD at 5 %</b>	<b>17.23</b>
<b>CV</b>	<b>5.09</b>

The maximum availability of nitrogen was recorded with (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) *i.e.*, 26.38 kg ha<sup>-1</sup> followed by (T<sub>5</sub>), receiving 25% reduction to RDF (120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer grade 205.94 kg ha<sup>-1</sup>, (T<sub>7</sub>) receiving 50% reduction to RDF(120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer 201.75 kg ha<sup>-1</sup>. However, minimum available nitrogen was recorded in (T<sub>1</sub>) *i.e.*, Absolute control 173.78 kg ha<sup>-1</sup>

Our results are similar to findings of Singh *et al.* (2019) they found that the neem and oil coated urea provided crops with slow release nitrogen and that why the nitrogen losses and nitrification rates both decreased. Similar results also have been reported by Hatano *et al.* (2019).

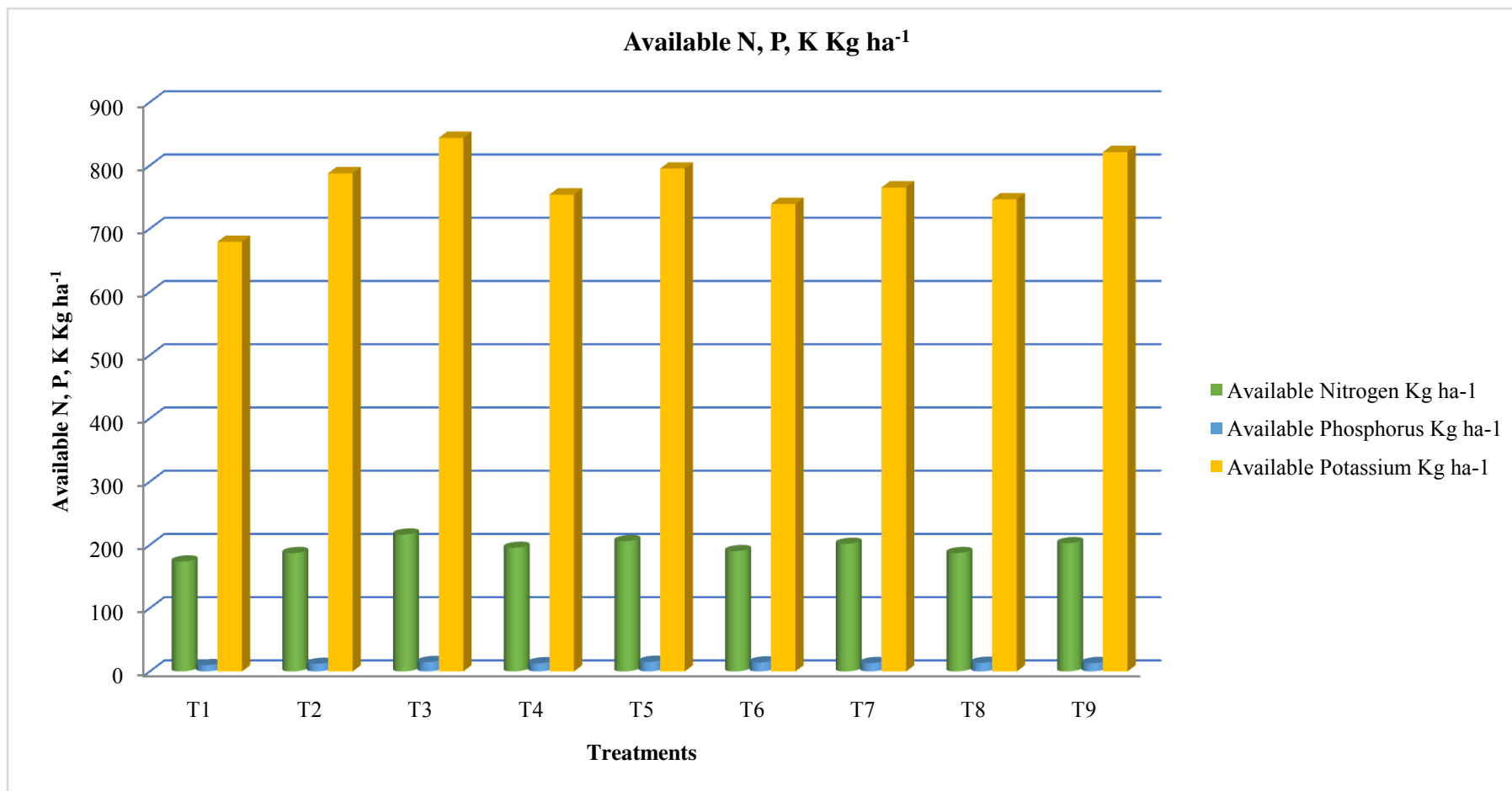
#### 4.5.2 Available phosphorus

The data pertaining to soil available phosphorus at harvest of Bt cotton showed statistically significant results due to coated fertilizer treatments (Table 4.16 and Fig 4.5). The initial available phosphorus in soil was 9.11 kg ha<sup>-1</sup>. It was found that availability of phosphorus varied from 9.91 to 15.14 kg ha<sup>-1</sup>.

**Table 4.16 Effect of coated fertilizer on available phosphorus in soil after harvest of Bt cotton.**

Treatments	Available Phosphorus (Kg ha <sup>-1</sup> )
T <sub>1</sub> - Absolute control	9.91
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	12.06
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	15.14
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	13.55
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	14.74
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	13.14
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	14.22
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	12.88
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	13.14
<b>S.Em.</b>	<b>0.47</b>
<b>C.D. at 5 %±</b>	<b>1.42</b>
<b>C.V. %</b>	<b>6.24</b>

The maximum availability of phosphorus was recorded with (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) *i.e.*, 15.14 kg ha<sup>-1</sup> followed by (T<sub>5</sub>), receiving 25% reduction to RDF (120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer grade 14.74 kg ha<sup>-1</sup>, (T<sub>7</sub>) receiving 50% reduction to RDF(120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer 14.22 kg ha<sup>-1</sup>. However, minimum available phosphorus was recorded in (T<sub>1</sub>) *i.e.*, Absolute control 9.91 kg ha<sup>-1</sup>. Our experimental results are to in corroborating with the findings of Noor *et al.* (2017), they observed that the comparing to all coating treatments and uncoated DAP. The double layer polymer coating on DAP fertilizer showed a maximisation trend of P release in soil and was



**Fig. 4.5 Effect of coated fertilizer on available N, P, K in soil (kg ha<sup>-1</sup>).**

match plant requirements for phosphorous. Similar results also have been reported by Lindsay *et al.* (1989).

#### 4.5.3 Available potassium

The data related to soil available potassium at harvest of Bt cotton showed statistically significant results due to coated fertilizer treatments (Table 4.17 and Fig 4.5). The initial available potassium in soil was 705.60 kg ha<sup>-1</sup>. It was found that availability of potassium varied from 679.47 to 843.73 kg ha<sup>-1</sup>.

The maximum availability of potassium was recorded with (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) *i.e.*, 843.73 kg ha<sup>-1</sup> followed by (T<sub>5</sub>), receiving 25% reduction to RDF (120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer grade 795.20 kg ha<sup>-1</sup>, (T<sub>7</sub>) receiving 50% reduction to RDF(120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer 765.33 kg ha<sup>-1</sup>. However, minimum available potassium was recorded in (T<sub>1</sub>) *i.e.*, Absolute control 679.47 kg ha<sup>-1</sup>.

**Table 4.17: Effect of coated fertilizer on available potassium in soil after harvest of Bt cotton.**

Treatments	Available Potassium (Kg ha <sup>-1</sup> )
T <sub>1</sub> - Absolute control	679.47
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	787.73
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	843.73
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	754.13
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	795.20
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	739.20
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	765.33
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	746.67
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	821.33
<b>S.Em.</b>	<b>27.81</b>
<b>C.D. at 5 %±</b>	<b>83.38</b>
<b>C.V. %</b>	<b>6.25</b>

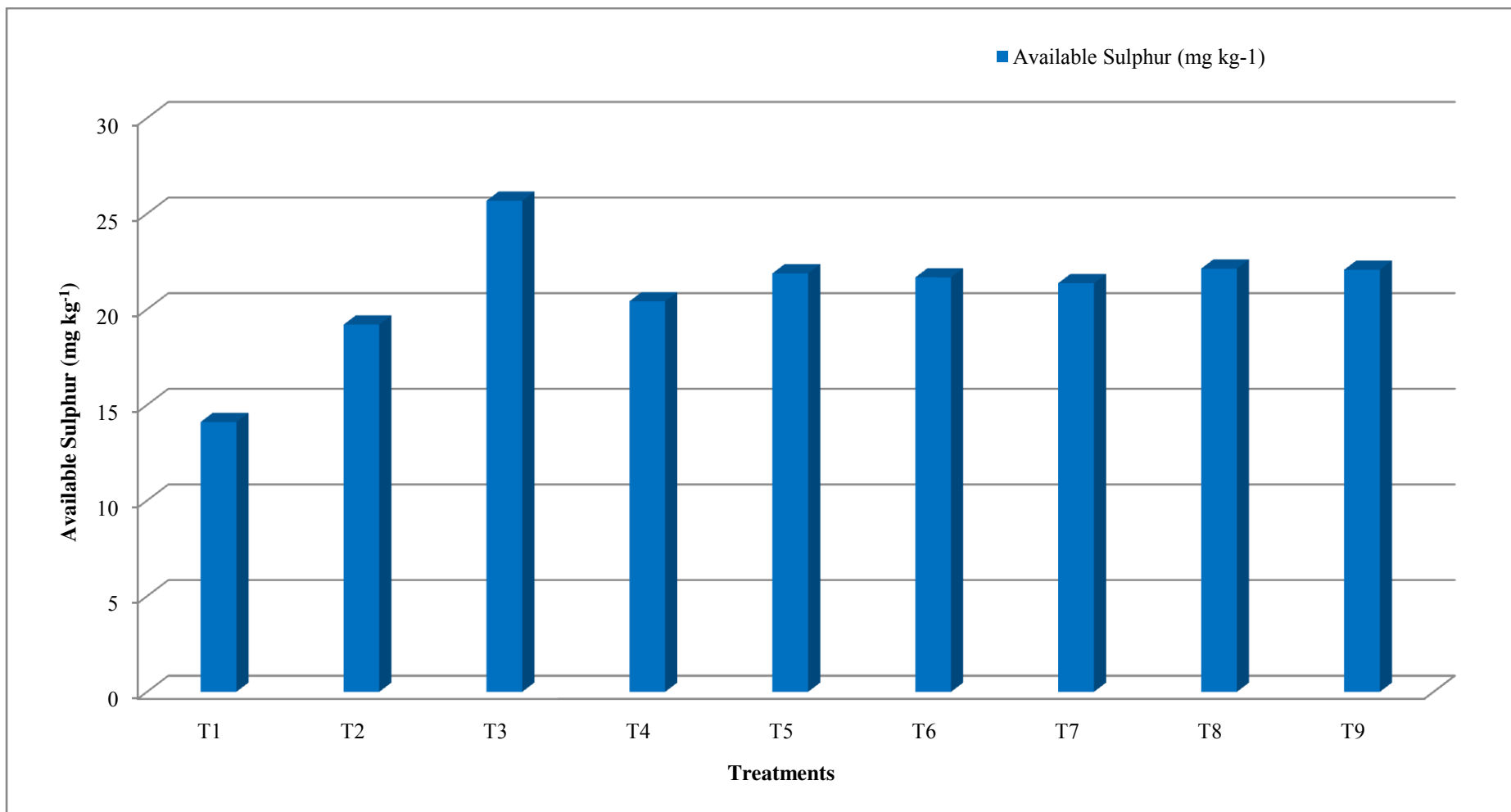
Our results are related to findings of Kumar *et al.* (2017), they observed that the presence of  $\text{NH}_4^+$  ions in the soil prevented the potassium from being mixed and enhanced potassium availability in the soil at time of crop harvest. Also, our results are in corroborating with the findings of Waikar *et al.* (2014), they observed that the high content of K is due to the occurrence of potash rich minerals like mica and feldspar in parent material of the soil of central farm of VNMKV, Parbhani.

#### 4.5.4 Available sulphur

The available sulphur was significantly influenced by coated fertilizer treatment (Table 4.18 and Fig 4.6). It was observed that, treatment RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) (T<sub>3</sub>) recorded highest soil available sulphur (25.68 mg kg<sup>-1</sup>) and it was statistically at par with soil available sulphur (21.88 C) found in the treatment 25% reduction to RDF (120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer grade (T<sub>5</sub>) followed by, (T<sub>7</sub>) receiving 50% reduction to RDF (120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer 21.37 .the significantly lowest soil available sulphur (14.11) was observed in absolute control (T<sub>1</sub>) respectively.

**Table 4.18: Effect of coated fertilizer on available sulphur in soil after harvest of Bt cotton.**

Treatments	Available Sulphur (mg kg <sup>-1</sup> )
T <sub>1</sub> - Absolute control	14.11
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	19.20
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	25.68
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	20.42
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	21.88
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	21.67
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	21.37
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	22.13
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	22.07
<b>SE m±</b>	<b>0.72</b>
<b>CD at 5 %</b>	<b>2.18</b>
<b>CV</b>	<b>6.02</b>



**Fig. 4.6.**Effect of coated fertilizer on available sulphur in soil after harvest of Bt cotton.

Our results are corresponds to finding of Ram *et al.* (2017), they observed that the application of gypsum at 30 and 60 kilogramme of sulphur per hectare and phosphogypsum at 30 and 60 kg of sulphur per hectare enhanced the soils sulphur status after two years of cropping systems.

#### **4.5.5 DTPA extractable iron**

The DTPA soil iron content as influenced by coated fertilizer treatment is reported in Table 4.19 and Fig 4.7. The initial value of DTPA extractable iron content in soil was 2.84 mg kg<sup>-1</sup>. DTPA Fe in soil ranged from 2.78 to 3.50 mg kg<sup>-1</sup> at harvest of Bt cotton. The highest build-up of soil DTPA Fe (3.50 mg kg<sup>-1</sup>) noticed in under application of RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) (T<sub>3</sub>) followed by (T<sub>5</sub>) receiving 25% reduction to RDF (120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer grade (3.35 mg kg<sup>-1</sup>), (T<sub>7</sub>) receiving 50% reduction to RDF(120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer (3.14 mg kg<sup>-1</sup>). However, minimum soil DTPA Fe was recorded in (T<sub>1</sub>) *i.e.*, Absolute control (2.78 mg kg<sup>-1</sup>). The data on soil DTPA Fe was found statistically non-significant.

Our experimental results are to in corroborating with the findings of Kumar *et al.* (2017), they observed that the nitrogen fertilizers (70 nd 85 percent RD-N) in combination with nitrogen inhibitor (Agroh N protect urea and neem coated urea) significantly increased the soils accessible micronutrient after the crop was harvested.

#### **4.5.6 DTPA extractable manganese**

The DTPA soil manganese content as influenced by coated fertilizer treatment is reported in Table 4.19 and Fig 4.7. The initial value of DTPA extractable manganese content in soil was 7.90 kg<sup>-1</sup>. DTPA Mn in soil ranged from 8.11 to 12.00 mg kg<sup>-1</sup> at harvest of Bt cotton. The highest build-up of soil DTPA Mn (12.00 mg kg<sup>-1</sup>) noticed in under application of RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) (T<sub>3</sub>) followed by (T<sub>5</sub>), receiving 25% reduction to RDF (120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer grade (10.25 mg kg<sup>-1</sup>), (T<sub>7</sub>) receiving 50% reduction to RDF(120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer (9.08 mg kg<sup>-1</sup>).

However, minimum soil DTPA Mn was recorded in (T<sub>1</sub>) *i.e.*, Absolute control (8.12 mg kg<sup>-1</sup>). The data on soil DTPA Mn was found statistically significant. Our

experimental results are to in corroborating with the findings of Kumar *et al.* (2017), they observed that the nitrogen fertilizers (70 nd 85 percent RD-N) in combination with nitrogen inhibitor (Agroh N protect urea and neem coated urea) significantly increased the soils accessible micronutrient after the crop was harvested.

#### **4.5.7 DTPA extractable copper**

The DTPA soil copper content as influenced by coated fertilizer treatment is reported in Table 4.19 and Fig 4.7. The initial value of DTPA extractable copper content in soil was 2.14 mg kg<sup>-1</sup>. DTPA Cu in soil ranged from 1.90 to 3.61 mg kg<sup>-1</sup> at harvest of Bt cotton. The highest build-up of soil DTPA Cu (3.61 mg kg<sup>-1</sup>) noticed in under application of RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) (T<sub>3</sub>) followed by (T<sub>5</sub>) receiving 25% reduction to RDF (120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer grade (3.32 mg kg<sup>-1</sup>), (T<sub>7</sub>) receiving 50% reduction to RDF(120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer (3.11 mg kg<sup>-1</sup>).

However, minimum soil DTPA Cu was recorded in (T<sub>1</sub>) *i.e.*, Absolute control (1.90 mg kg<sup>-1</sup>). The data on soil DTPA Cu was found statistically significant. Our experimental results are to in corroborating with the findings of Kumar *et al.* (2017), they observed that the nitrogen fertilizers (70 nd 85 percent RD-N) in combination with nitrogen inhibitor (Agroh N protect urea and neem coated urea) significantly increased the soils accessible micronutrient after the crop was harvested. The high Cu content in soil might be due to presence of Cu minerals like Cuprite and Chalcosite in parent material.

#### **4.5.8 DTPA extractable Zinc**

The DTPA soil zinc content as influenced by coated fertilizer treatment is reported in Table 4.19 and Fig 4.7. The initial value of DTPA extractable zinc content in soil was 0.49 mg kg<sup>-1</sup>. DTPA Zn in soil ranged from 0.49 to 0.67 mg kg<sup>-1</sup> at harvest of Bt cotton. The highest build-up of soil DTPA Zn (0.67 mg kg<sup>-1</sup>) noticed in under application of RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) (T<sub>3</sub>) followed by (T<sub>5</sub>) receiving 25% reduction to RDF (120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer grade (0.50 mg kg<sup>-1</sup>), (T<sub>7</sub>) receiving 50% reduction to RDF(120:60:60 Kg NPK ha<sup>-1</sup>) with coated fertilizer (0.51 mg kg<sup>-1</sup>).

**Table 4.19: Effect of coated fertilizer on DTPA extractable micronutrient (Available Fe, Mn, Cu, Zn) in soil after harvest of cotton.**

Treatments	Soil Micronutrient (mg kg <sup>-1</sup> )			
	Available Fe	Available Mn	Available Cu	Available Zn
T <sub>1</sub> - Absolute control	2.78	8.12	1.90	0.49
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	3.16	8.56	2.04	0.51
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	3.50	12.00	3.61	0.67
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	3.35	10.10	3.24	0.54
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	3.35	10.52	3.32	0.50
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	3.13	8.92	2.97	0.59
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	3.14	9.08	3.11	0.51
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	3.18	8.88	3.12	0.47
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	3.14	10.07	3.25	0.59
<b>SE m±</b>	<b>0.15</b>	<b>0.26</b>	<b>0.18</b>	<b>0.02</b>
<b>CD at 5 %</b>	<b>NS</b>	<b>0.80</b>	<b>0.55</b>	<b>0.08</b>
<b>CV</b>	<b>8.18</b>	<b>4.83</b>	<b>10.77</b>	<b>9.08</b>

However, minimum soil DTPA Zn was recorded in (T<sub>1</sub>) *i.e.*, Absolute control (0.49 mg kg<sup>-1</sup>). The data on soil DTPA Zn was found statistically significant. Our experimental results are to in corroborating with the findings of Kumar *et al.* (2017), they observed that the nitrogen fertilizers (70 nd 85 percent RD-N) in combination with nitrogen inhibitor (Agroh N protect urea and neem coated urea) significantly increased the soils accessible micronutrient after the crop was harvested. Zinc is found deficient in black soil because presence of calcium carbonate decreases the

availability of Zinc due to higher soil pH. Similar results found by Kurhade *et al.* (2014) and Verma *et al.* (2015).

#### 4.6 Effect of coated fertilizer on nutrient content in Bt cotton after harvest of crop.

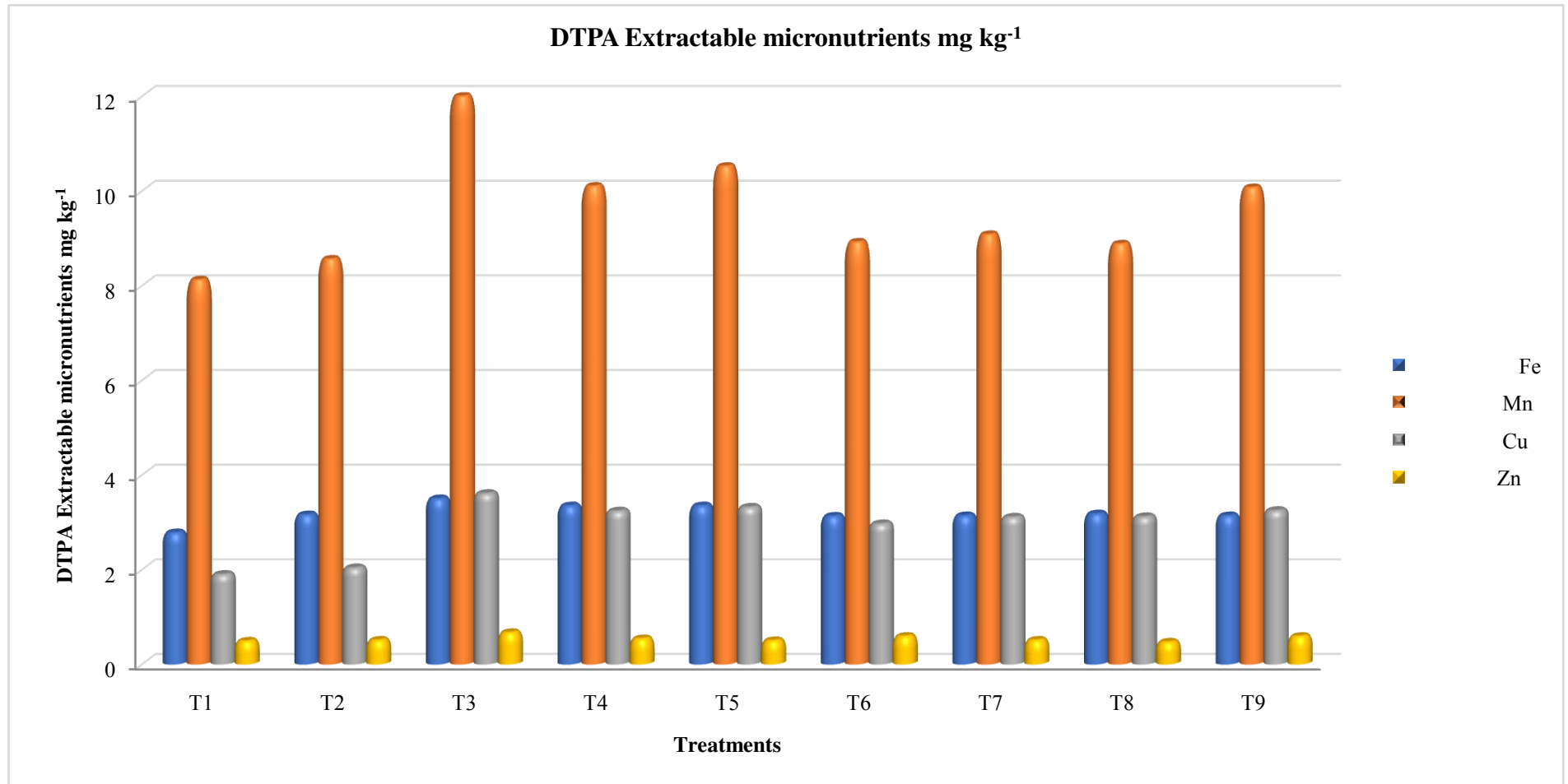
##### 4.6.1 Nitrogen concentration in seed and straw

The effect of coated fertilizer on nitrogen concentration at harvest of Bt cotton is given in Table 4.20 and Fig 4.8. Nitrogen concentration was varied from 0.15 to 0.27 in seed and 0.25 to 0.96 in straw of Bt cotton, respectively. Nitrogen concentration in seed and straw of Bt cotton was found significantly highest (0.27 %) in seed and (.025 %) in straw with treatment ((T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) followed by T<sub>5</sub>>T<sub>7</sub>>T<sub>4</sub>>T<sub>6</sub>>T<sub>8</sub>>T<sub>9</sub>, respectively. Lowest nitrogen concentration in seed and straw of Bt cotton noticed in absolute control (T<sub>1</sub>).

**Table 4.20: Nitrogen concentration in seed and straw after harvest of Bt cotton.**

Treatments	Nitrogen Concentration (%)	
	Seed	Straw
T <sub>1</sub> - Absolute control	1.58	1.30
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	1.64	1.31
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	1.96	1.39
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	1.68	1.24
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	1.80	1.33
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	1.87	1.31
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	1.77	1.30
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	1.75	1.29
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	1.75	1.26
<b>SE m±</b>	<b>0.04</b>	<b>0.04</b>
<b>CD at 5 %</b>	<b>0.12</b>	<b>NS</b>
<b>CV</b>	<b>4.08</b>	<b>5.44</b>

Similar findings were also reported by Bharambe and Tomer (2004). Increase in potassium content and uptake was might be due to their synergetic relationship with nitrogen and phosphorus.



**Fig. 4.7** Effect of coated fertilizer on DTPA extractable micronutrient (Available Fe, Mn, Cu, Zn) in soil after harvest of Bt cotton.

#### 4.6.2 Phosphorus concentration in seed and straw

The effect of coated fertilizer on Phosphorus concentration at harvest of Bt cotton is given in Table 4.21 and Fig 4.8. Phosphorus concentration was varied from 1.58 to 1.96 in seed and 1.30 to 1.39 in straw of Bt cotton, respectively.

**Table 4.21: Phosphorus concentration in seed and straw after harvest of Bt cotton.**

Treatments	Phosphorous Concentration (%)	
	Seed	Straw
T <sub>1</sub> - Absolute control	0.15	0.25
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	0.17	0.33
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	0.27	0.96
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	0.17	0.56
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	0.21	0.69
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	0.18	0.50
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	0.18	0.61
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	0.17	0.42
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	0.17	0.39
<b>SE m±</b>	<b>0.01</b>	<b>0.03</b>
<b>CD at 5 %</b>	<b>0.03</b>	<b>0.09</b>
<b>CV</b>	<b>10.62</b>	<b>10.37</b>

Phosphorus concentration in seed and straw of Bt cotton was found significantly highest (1.96 %) in seed and (1.39 %) in straw with treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) followed by T<sub>5</sub>>T<sub>7</sub>>T<sub>4</sub>>T<sub>6</sub>>T<sub>8</sub>>T<sub>9</sub>, respectively. Lowest Phosphorus concentration in seed and straw of Bt cotton noticed in absolute control (T<sub>1</sub>). Our results are related to findings of Ali *et al.* (2017), they

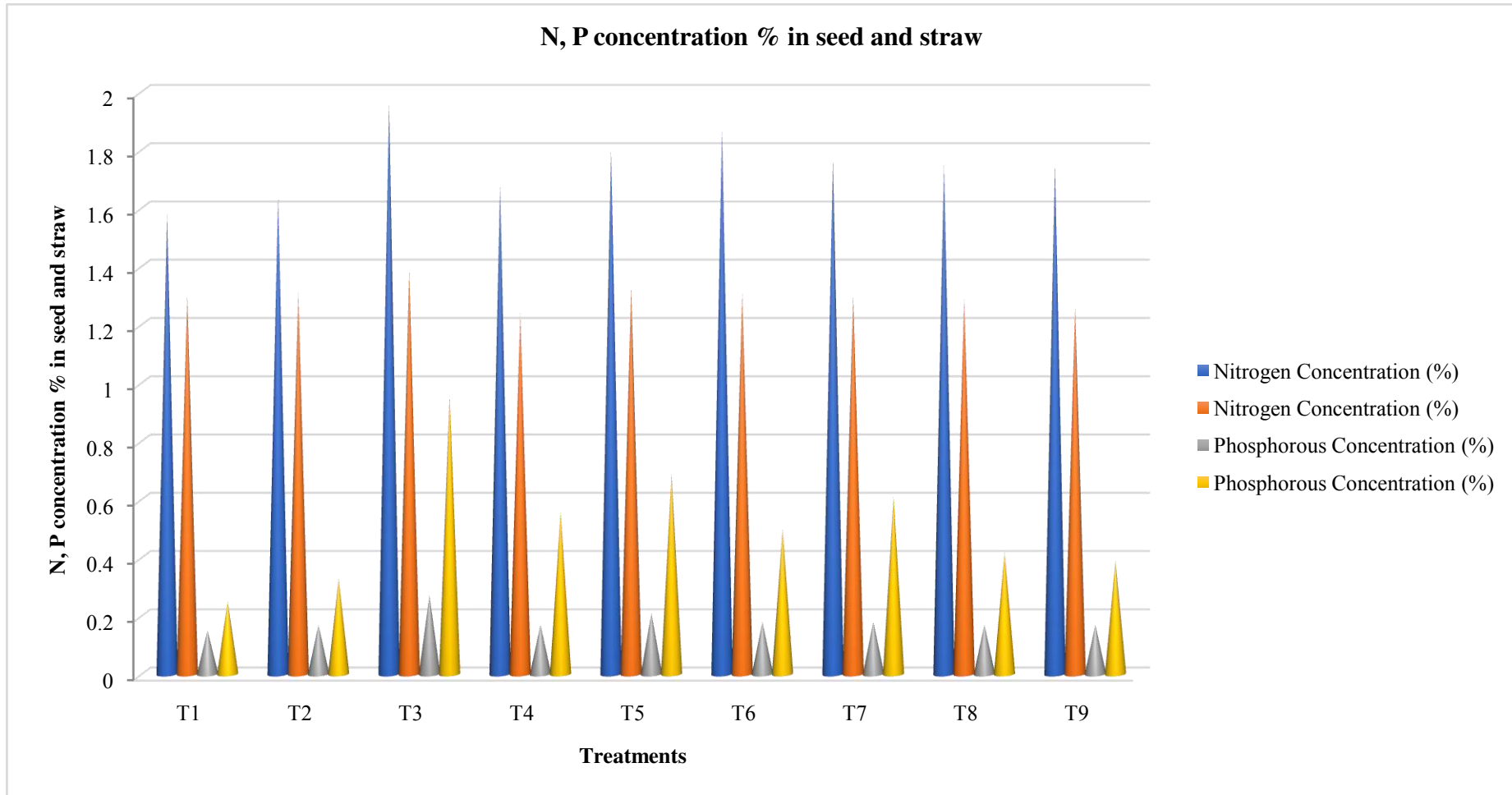
noticed that the application of a full dose of fertilizer through polymer coated DAP caused the absorption of phosphorus in grain and straw to increased.

Similar findings were also reported by Bharambe and Tomer (2004). Increase in potassium content and uptake was might be due to their synergetic relationship with nitrogen and phosphorus.

#### **4.6.3 Potassium concentration in seed and straw**

The effect of coated fertilizer on Potassium concentration at harvest of Bt cotton is given in Table 4.22 and Fig 4.9. Potassium concentration was varied from 0.25 to 0.48 in seed and 1.07 to 1.33 in straw of Bt cotton, respectively. Potassium concentration in seed and straw of Bt cotton was found significantly highest (0.48 %) in seed and (1.33 %) in straw with treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) followed by T<sub>5</sub>>T<sub>7</sub>>T<sub>4</sub>>T<sub>6</sub>>T<sub>8</sub>>T<sub>9</sub>, respectively. Lowest Potassium concentration in seed and straw of Bt cotton noticed in absolute control (T<sub>1</sub>).

Our results are correspond to findings of Ghafoor *et al.* (2021), they observed that coated N-based fertilizers and P and K had synergistic effects. They found that the treatment with 30 kg ha<sup>-1</sup> n using bioactive sulphur coated urea resulted in the noticeably greatest P and K absorption kg ha<sup>-1</sup>.



**Fig. 4.8 Effect of coated fertilizer on nitrogen and phosphorus concentration in seed and straw after harvest of Bt cotton.**

**Table 4.22: Potassium concentration in seed and straw after harvest of Bt cotton.**

Treatments	Potassium Concentration (%)	
	Seed	Straw
T <sub>1</sub> - Absolute control	0.25	1.07
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	0.29	1.17
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	0.48	1.33
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	0.42	1.28
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	0.44	1.29
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	0.37	1.26
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	0.41	1.25
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	0.32	1.22
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	0.34	1.20
<b>SE m±</b>	<b>0.01</b>	<b>0.02</b>
<b>CD at 5 %</b>	<b>0.03</b>	<b>0.06</b>
<b>CV</b>	<b>5.54</b>	<b>3.01</b>

**4.6.4: Sulphur concentration in seed and straw**

The seed and straw sulphur content as influenced by coated fertilizer is presented in Table 4.23 and Fig 4.9. The seed sulphur content was ranged 0.42 to 0.53 in percent. The significantly highest seed sulphur content (0.53 %) was observed in treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2). The lowest seed sulphur content was recorded in the absolute control (T<sub>1</sub>). The lowest seed sulphur content (0.42) was recorded in the absolute control (T<sub>1</sub>). The straw sulphur content was varied from 0.17 to 0.30. The significantly highest straw content (0.30 %) was observed in treatment (T<sub>3</sub>) with RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2). The lowest seed sulphur content (0.17 %) was recorded in the absolute control (T<sub>1</sub>). Our results are related to findings

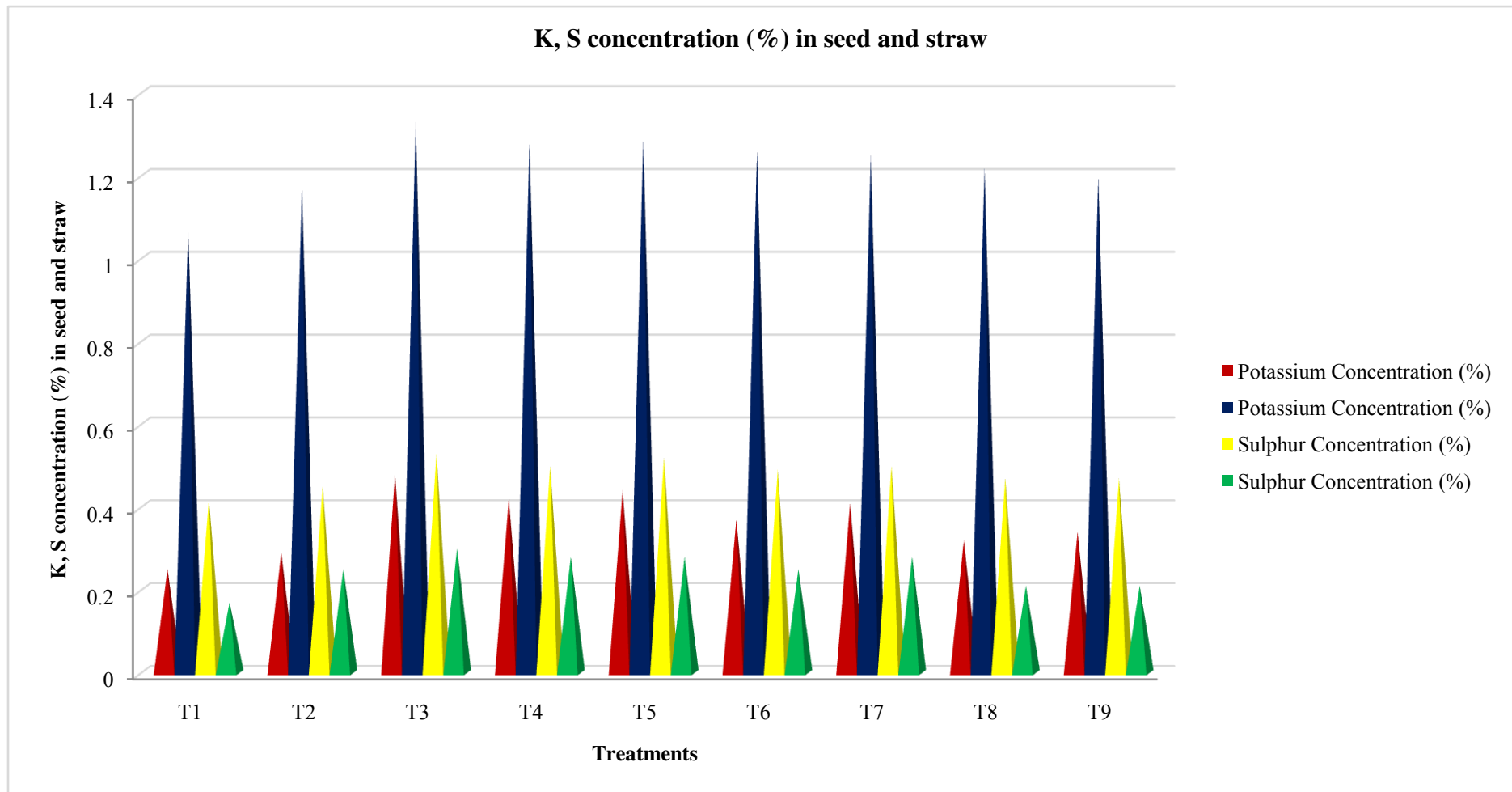
of Kumar *et al.* (2018), they noticed that the application of S through bentonite increase the seed and stover yield and higher sulphur content.

**Table 4.23: Sulphur concentration in seed and straw after harvest of Bt cotton.**

Treatments	Sulphur Concentration (%)	
	Seed	Straw
T <sub>1</sub> - Absolute control	0.42	0.17
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	0.45	0.25
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	0.53	0.30
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	0.50	0.28
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	0.52	0.28
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	0.49	0.25
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	0.50	0.28
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	0.47	0.21
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	0.47	0.21
<b>SE m±</b>	<b>0.01</b>	<b>0.01</b>
<b>CD at 5 %</b>	<b>0.02</b>	<b>0.05</b>
<b>CV</b>	<b>3.11</b>	<b>13.49</b>

#### 4.6.5 Iron concentration in seed and straw

The concentration of Fe in Bt cotton was influenced significantly and increased due to application of coated fertilizer as compare to non coated fertilizer. Data presented in Table 4.24 and Fig 4.10. Iron concentration in seed and straw ranged from (65.97 to 130.50 %) and (173.50 to 263.67 %). Iron concentration was recorded significantly highest in seed (30.50 %) and in straw (263.67 %) in the treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) followed by



**Fig. 4.9** Effect of coated fertilizer on potassium and sulphur concentration in seed and straw after harvest of Bt cotton.

T<sub>5</sub>>T<sub>7</sub>>T<sub>4</sub>>T<sub>6</sub>>T<sub>8</sub>>T<sub>9</sub>, respectively. Lowest iron concentration in seed and straw of Bt cotton noticed in absolute control (T<sub>1</sub>). Our experimental results are to corroborating with the findings of Klikocha *et al.* (2020), they observed that the application of sulphur based NPK fertilizer increased Fe, Mn, Zn, Cu content and absorption in crop

**Table 4.24 Iron concentration in seed and straw after harvest of Bt cotton.**

Treatments	Iron Concentration (%)	
	Seed	Straw
T <sub>1</sub> - Absolute control	65.97	173.50
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	78.00	202.80
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	130.50	263.67
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	124.80	232.90
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	129.87	245.70
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	106.37	226.40
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	91.03	235.37
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	103.80	213.10
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	90.53	230.83
<b>SE m±</b>	<b>11.42</b>	<b>10.84</b>
<b>CD at 5 %</b>	<b>34.26</b>	<b>32.52</b>
<b>CV</b>	<b>19.35</b>	<b>8.36</b>

#### 4.6.6 Manganese concentration in seed and straw

The concentration of Mn in Bt cotton was influenced significantly and increased due to application of coated fertilizer as compare to non-coated fertilizer. Data presented in Table 4.25 and Fig 4.10. Manganese concentration in seed and straw ranged from (42.77 to 48.20 %) and (80.50 to 95.70 %). Manganese concentration was recorded significantly highest in seed (48.20 %) and in straw (95.70 %) in the treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) followed by T<sub>5</sub>>T<sub>7</sub>>T<sub>4</sub>>T<sub>6</sub>>T<sub>8</sub>>T<sub>9</sub>, respectively. Lowest Manganese concentration in seed and straw of Bt cotton noticed in absolute control (T<sub>1</sub>). Our experimental results are to in

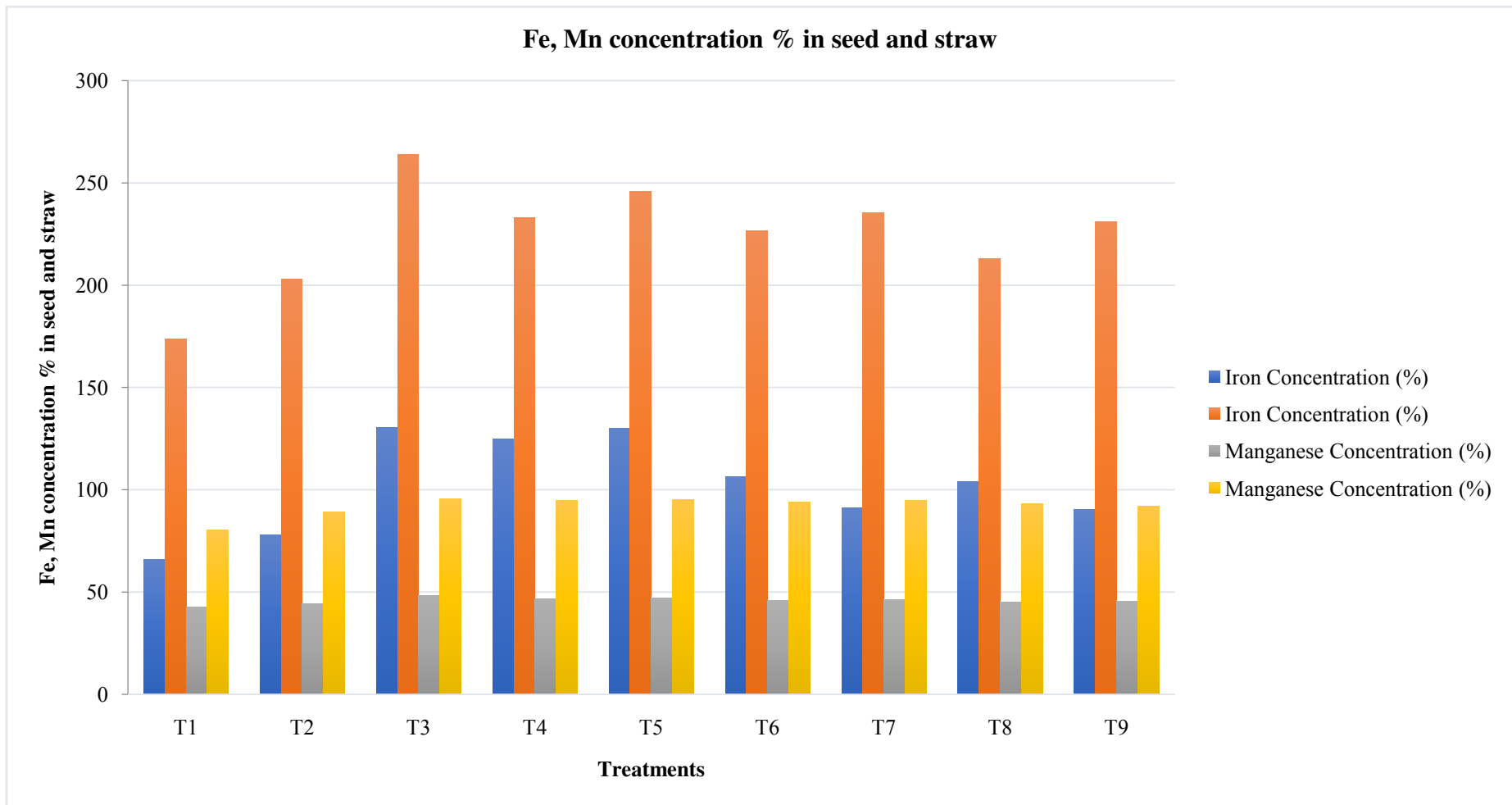
corroborating with the findings of Klikocha *et al.* (2020), they observed that the application of sulphur based NPK fertilizer increased Fe, Mn, Zn, Cu content and absorption in crop.

**Table 4.25: Manganese concentration in seed and straw after harvest of Bt cotton.**

Treatments	Manganese Concentration (%)	
	Seed	Straw
T <sub>1</sub> - Absolute control	42.77	80.50
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	44.17	89.00
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	48.20	95.70
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	46.60	94.87
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	47.13	95.20
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	45.83	93.90
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	46.33	94.73
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	45.13	93.10
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	45.40	92.10
<b>SE m±</b>	<b>0.33</b>	<b>1.23</b>
<b>CD at 5 %</b>	<b>1.00</b>	<b>3.70</b>
<b>CV</b>	<b>1.27</b>	<b>2.32</b>

#### 4.6.7 Copper concentration in seed and straw

The concentration of Cu in Bt cotton was influenced significantly and increased due to application of coated fertilizer as compare to non coated fertilizer. Data presented in Table 4.26 and Fig 4.11. Copper concentration in seed and straw ranged from (7.70 to 18.30 %) and (14.43 to 29.47 %). Copper concentration was recorded significantly highest in seed (18.30 %) and in straw (29.47 %) in the treatment T<sub>3</sub> with application of treatment with RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)



**Fig. 4.10** Effect of coated fertilizer on iron and manganese concentration in seed and straw after harvest of Bt cotton.

followed by T<sub>5</sub>>T<sub>7</sub>>T<sub>4</sub>>T<sub>6</sub>>T<sub>8</sub>>T<sub>9</sub>, respectively. Lowest Copper concentration in seed and straw of Bt cotton noticed in absolute control (T<sub>1</sub>). Our experimental results are to in corroborating with the findings of Klikocha *et al.* (2020), they observed that the application of sulphur based NPK fertilizer increased Fe, Mn, Zn, Cu content and absorption in crop.

**Table 4.26: Copper concentration in seed and straw after harvest of Bt cotton.**

Treatments	Copper Concentration (%)	
	Seed	Straw
T <sub>1</sub> - Absolute control	7.70	14.43
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	13.63	17.80
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	18.30	29.47
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	17.73	28.20
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	18.63	28.63
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	16.73	27.23
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	17.97	28.13
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	16.53	24.87
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	16.33	20.53
<b>SE m±</b>	<b>1.10</b>	<b>0.70</b>
<b>CD at 5 %</b>	<b>3.31</b>	<b>2.11</b>
<b>CV</b>	<b>11.99</b>	<b>5.01</b>

#### 4.6.8 Zinc concentration in seed and straw

The concentration of Zn in Bt cotton was influenced significantly and increased due to application of coated fertilizer as compare to non coated fertilizer. Data presented in Table 4.27 and Fig 4.11. Zinc concentration in seed and straw ranged from (3.93 to 45.00 %) and (57.27 to 66.33 %). Zinc concentration was recorded significantly highest in seed (45.00 %) and in straw (66.33 %) in the treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) followed by T<sub>5</sub>>T<sub>7</sub>>T<sub>4</sub>>T<sub>6</sub>>T<sub>8</sub>>T<sub>9</sub>, respectively. Lowest Zinc concentration in seed and straw of Bt cotton noticed in absolute control (T<sub>1</sub>). Our experimental results are to in

corroborating with the findings of Klikocha et al. (2020), they observed that the application of sulphur based NPK fertilizer increased Fe, Mn, Zn, Cu content and absorption in crop.

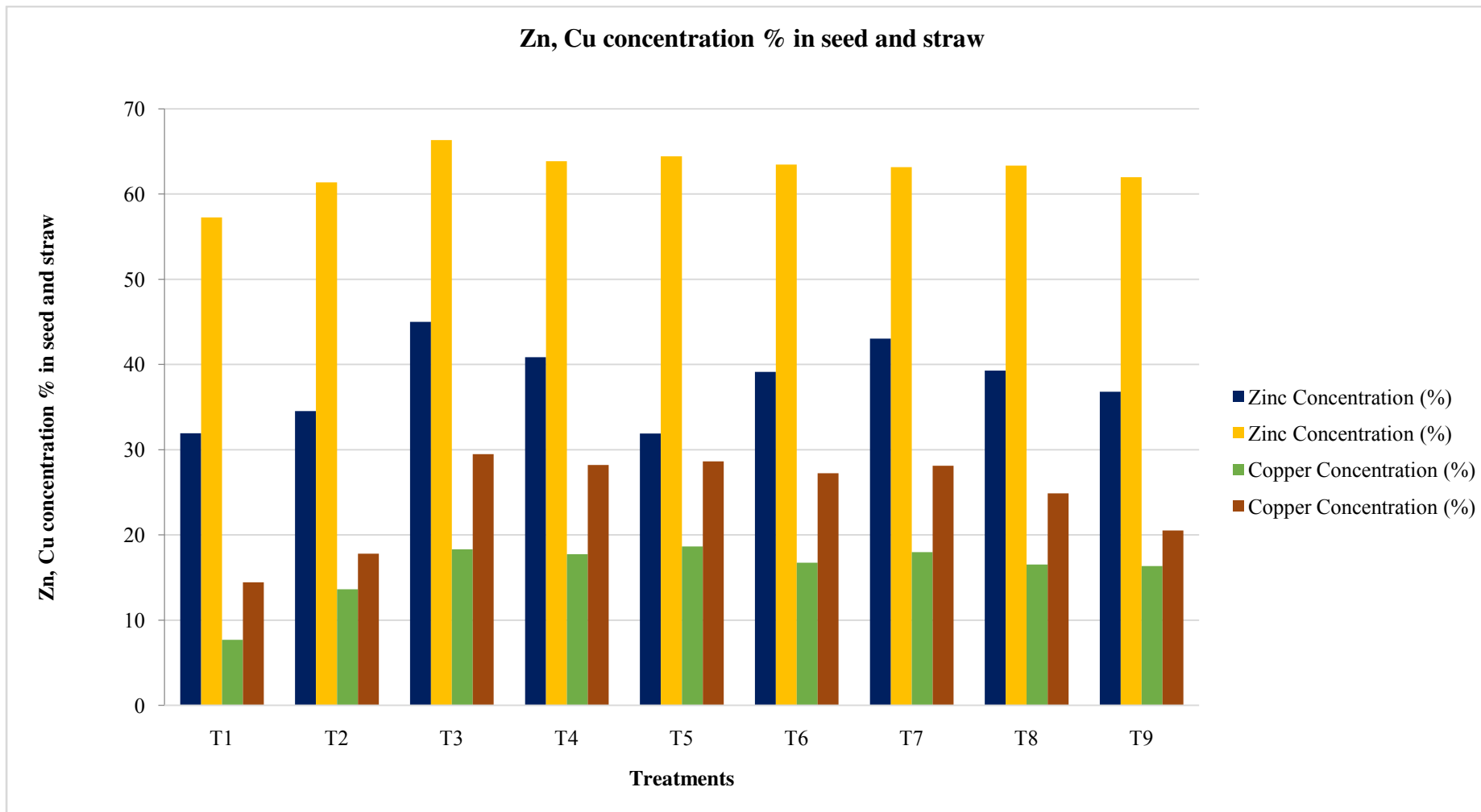
**Table 4.27: Zinc concentration in seed and straw after harvest of Bt cotton.**

Treatments	Zinc Concentration (%)	
	Seed	Straw
T <sub>1</sub> - Absolute control	31.93	57.27
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	34.53	61.37
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	45.00	66.33
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	40.87	63.87
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	31.90	64.43
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	39.13	63.47
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	43.03	63.17
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	39.27	63.33
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	36.80	61.97
<b>SE m±</b>	<b>4.53</b>	<b>0.52</b>
<b>CD at 5 %</b>	<b>NS</b>	<b>1.57</b>
<b>CV</b>	<b>20.62</b>	<b>1.45</b>

#### **4.7: Effect of coated fertilizer on nutrient uptake by Bt cotton after harvest of crop.**

##### **4.7.1 Nitrogen uptake in Bt cotton**

The data related to nitrogen uptake in Bt cotton influenced by coated fertilizer are given in Table 4.28 and Fig 4.12. The uptake of nitrogen by seed and straw are calculated separately and total nitrogen uptake by crop was calculated. The uptake of nitrogen by seed, straw and total N uptake after harvest varied in the range of (8.39 to 32.67), (31.22 to 40.16) and (39.61 to 72.83) kg ha<sup>-1</sup>.



**Fig. 4.11 Effect of coated fertilizer on copper and zinc concentration in seed and straw after harvest of Bt cotton.**

**Table 4.28: Effect of coated fertilizer on nitrogen uptake in Bt cotton after harvest of crop.**

Treatments	N uptake (kg ha <sup>-1</sup> )		Total N uptake (kg ha <sup>-1</sup> )
	Seed	Straw	
T <sub>1</sub> - Absolute control	8.39	31.22	39.61
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	14.19	33.86	48.05
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	32.67	40.16	72.83
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	22.89	34.68	57.57
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	23.99	37.53	61.52
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	21.93	36.27	58.20
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	17.98	36.03	54.01
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	14.95	35.29	50.24
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	19.17	35.40	54.47
<b>SE m±</b>	<b>0.61</b>	<b>1.12</b>	<b>1.31</b>
<b>CD at 5 %</b>	<b>1.85</b>	<b>3.37</b>	<b>3.95</b>
<b>CV</b>	<b>5.46</b>	<b>5.48</b>	<b>4.14</b>

The highest nitrogen uptake was recorded with treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) in seed, straw and total uptake, followed by T<sub>5</sub>>T<sub>7</sub>>T<sub>4</sub>>T<sub>6</sub>>T<sub>8</sub>>T<sub>9</sub>, respectively. The lowest N uptake was observed in absolute control (T<sub>1</sub>). The data was found statistically significant. Our results are related to findings of Kumar *et al.* (2010), they noticed that the in comparison to other coating levels of neem oil prilled urea increased the nitrogen uptake in crop.

#### 4.7.2 Phosphorus uptake in Bt cotton

The data pertaining to Phosphorus uptake in Bt cotton influenced by coated fertilizer are given in Table 4.29 and Fig 4.12. The uptake of Phosphorus by seed and straw are calculated separately and total Phosphorus uptake by crop was calculated.

The uptake of Phosphorus by seed, straw and total P uptake after harvest varied in the range of (0.91 to 4.44), (5.90 to 27.74) and (6.81 to 32.19) kg ha<sup>-1</sup>. The highest Phosphorus uptake was recorded with treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) in seed, straw and total uptake, followed by T<sub>5</sub>>T<sub>7</sub>>T<sub>4</sub>>T<sub>6</sub>>T<sub>8</sub>>T<sub>9</sub>, respectively. The lowest P uptake was observed in absolute control (T<sub>1</sub>). The data was found statistically significant. Our results are related to findings of Sanders *et al.* (2012), they observed that the under a variety of soil conditions and crop types, the avail polymer has beneficial impacts on the availability and uptake of fertilizer phosphorus.

**Table 4.29 Effect of coated fertilizer on phosphorus uptake in Bt cotton after harvest of crop.**

Treatments	P uptake (kg ha <sup>-1</sup> )		Total P uptake (kg ha <sup>-1</sup> )
	Seed	Straw	
T <sub>1</sub> - Absolute control	0.91	5.90	6.81
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	1.48	8.46	9.94
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	4.44	27.74	32.19
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	2.33	15.68	18.15
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	2.97	19.37	22.34
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	2.06	13.88	15.94
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	1.78	14.83	16.61
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	1.44	11.52	12.97
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	1.90	10.88	12.77
<b>SE m±</b>	<b>0.17</b>	<b>1.02</b>	<b>1.12</b>
<b>CD at 5 %</b>	<b>0.52</b>	<b>3.06</b>	<b>3.36</b>
<b>CV</b>	<b>14.02</b>	<b>12.44</b>	<b>11.85</b>

#### 4.7.3 Potassium uptake in Bt cotton

The results related to Potassium uptake in Bt cotton influenced by coated fertilizer are given in Table 4.30 and Fig 4.12. The uptake of Potassium by seed and straw are calculated separately and total Potassium uptake by crop was calculated. The uptake of Potassium by seed, straw and total K uptake after harvest varied in the range of (1.34 to 8.00), (25.67 to 38.48) and (27.01 to 46.48) kg ha<sup>-1</sup>. The highest Potassium uptake was recorded with treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) in seed, straw and total uptake, followed by T<sub>5</sub>>T<sub>7</sub>>T<sub>4</sub>>T<sub>6</sub>>T<sub>8</sub>>T<sub>9</sub>, respectively. The lowest K uptake was observed in absolute

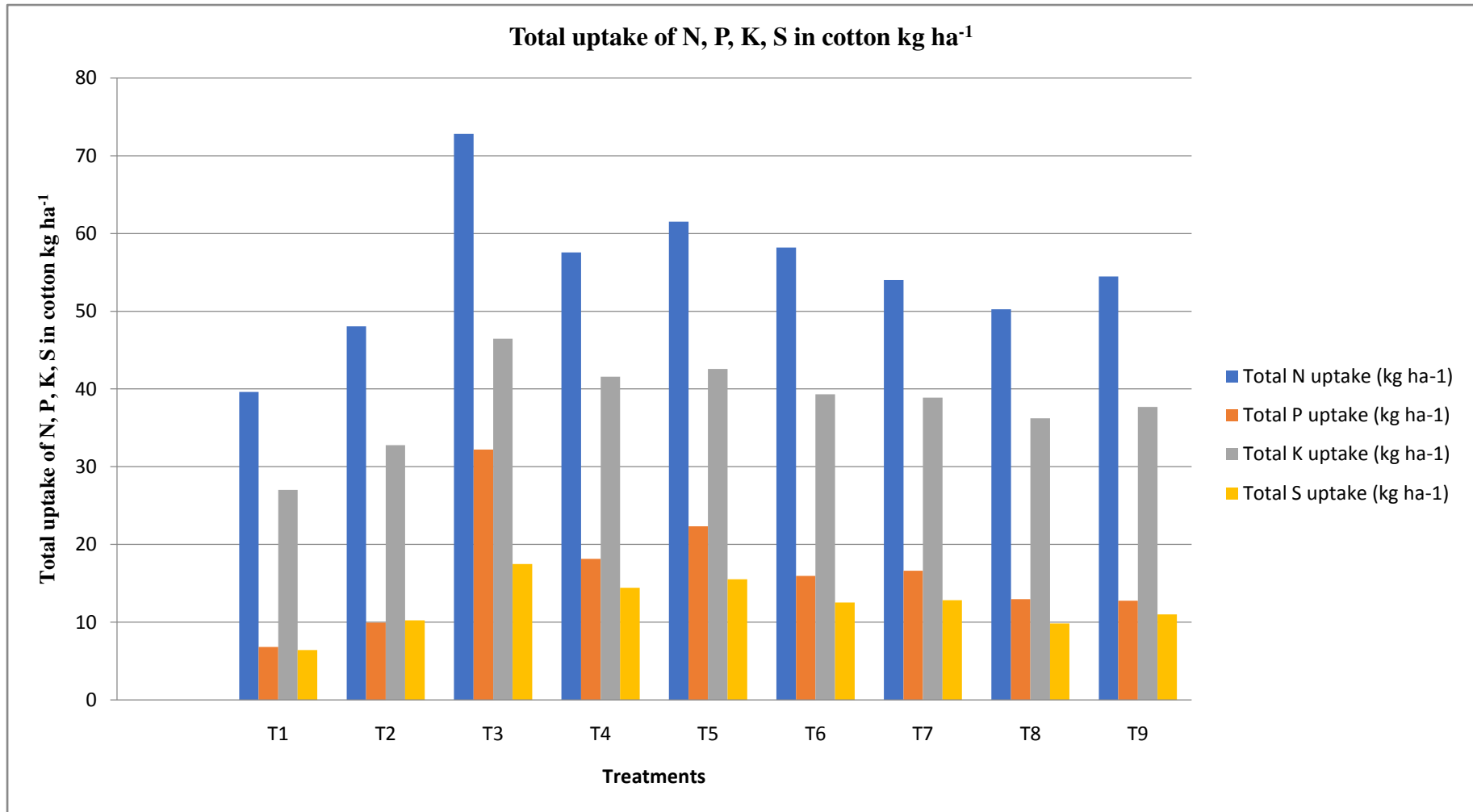
control (T<sub>1</sub>). The data was found statistically significant. Our results are related to findings of Kumar *et al.* (2017), they observed that the presence of NH<sub>4</sub><sup>+</sup> ions in the soil prevented the potassium from being mixed and enhanced potassium availability in the soil at time of crop harvest. Also our results are in corroborating with the findings of Waikar *et al.* (2014), they observed that the high content of K is due to the occurrence of potash rich minerals like mica and feldspar in parent material of the soil of central farm of VNMKV, Parbhani.

**Table 4.30: Effect of coated fertilizer on potassium uptake in Bt cotton after harvest of crop.**

Treatments	K uptake (kg ha <sup>-1</sup> )		Total K uptake (kg ha <sup>-1</sup> )
	Seed	Straw	
T <sub>1</sub> - Absolute control	1.34	25.67	27.01
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	2.53	30.23	32.76
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	8.00	38.48	46.48
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	5.72	35.86	41.59
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	6.29	36.27	42.56
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	4.33	34.99	39.31
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	4.19	34.71	38.90
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	2.71	33.52	36.23
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	3.71	33.98	37.69
SE m±	0.15	0.57	0.50
CD at 5 %	0.47	1.71	1.50
CV	6.35	2.94	2.28

#### 4.7.4 Sulphur uptake in Bt cotton

The results related to Sulphur uptake in Bt cotton influenced by coated fertilizer are given in Table 4.31 and Fig 4.12. The uptake of Sulphur by seed and straw are calculated separately and total Sulphur uptake by crop was calculated. The



**Fig. 4.12 Effect of coated fertilizer on total uptake of N, P, K and S of Bt cotton.**

uptake of Sulphur by seed, straw and total S uptake after harvest varied in the range of (2.25 to 8.83), (4.17 to 8.66) and (6.42 to 17.49) kg ha<sup>-1</sup>.

**Table 4.31: Effect of coated fertilizer on sulphur uptake in Bt cotton after harvest of crop.**

Treatments	S uptake (kg ha <sup>-1</sup> )		Total S uptake (kg ha <sup>-1</sup> )
	Seed	Straw	
T <sub>1</sub> - Absolute control	2.25	4.17	6.42
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	3.86	6.39	10.25
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	8.83	8.66	17.49
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	6.81	7.61	14.42
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	7.55	7.96	15.51
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	5.69	6.85	12.54
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	5.07	7.77	12.84
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	3.99	5.84	9.83
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	5.09	5.90	10.99
<b>SE m±</b>	<b>0.10</b>	<b>0.51</b>	<b>0.52</b>
<b>CD at 5 %</b>	<b>0.32</b>	<b>1.55</b>	<b>1.57</b>
<b>CV</b>	<b>3.46</b>	<b>13.20</b>	<b>7.42</b>

The highest Sulphur uptake was recorded with treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) in seed, straw and total uptake, followed by T<sub>5</sub>>T<sub>7</sub>>T<sub>4</sub>>T<sub>6</sub>>T<sub>8</sub>>T<sub>9</sub>, respectively. The lowest S uptake was observed in absolute control (T<sub>1</sub>). The data was found statistically significant. Our results are correspond to findings of Kumar *et al.* (2018), they noticed that higher sulphur uptake seen in treatment receiving bentonite sulphur as source of sulphur.

#### 4.7.5 Iron uptake in Bt cotton

The results related to Iron uptake in Bt cotton influenced by coated fertilizer are given in Table 4.32 and Fig 4.13. The uptake of Iron by seed and straw are calculated separately and total Iron uptake by crop was calculated. The uptake of Iron by seed, straw and total Fe uptake after harvest varied in the range of (35.09 to 217.51), (417.61 to 761.31) and (452.27 to 978.82) g ha<sup>-1</sup>.

**Table 4.32: Effect of coated fertilizer on iron uptake in Bt cotton after harvest of crop.**

Treatments	Fe uptake (g ha <sup>-1</sup> )		Total Fe uptake (g ha <sup>-1</sup> )
	Seed	Straw	
T <sub>1</sub> - Absolute control	35.09	417.61	452.27
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	67.39	526.09	593.48
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	217.51	761.31	978.82
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	170.10	650.95	821.05
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	187.39	690.90	878.30
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	124.55	628.71	753.26
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	126.23	653.61	779.94
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	88.95	583.89	672.84
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	98.95	632.48	731.43
SE m±	4.79	29.88	0.49
CD at 5 %	14.37	89.58	1.47
CV	6.70	8.40	0.11

The highest Iron uptake was recorded with treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) in seed, straw and total uptake, followed by T<sub>5</sub>>T<sub>7</sub>>T<sub>4</sub>>T<sub>6</sub>>T<sub>8</sub>>T<sub>9</sub>, respectively. The lowest Fe uptake was observed in absolute

control (T<sub>1</sub>). The data was found statistically significant. Our results are similar to the findings of Namdev *et al.* (1992), they recorded the foliar spraying of 1% Micnef (containing Fe, Mn, Cu, Zn, Mo, and B) highest content and uptake of micronutrient.

#### 4.7.6 Manganese uptake in Bt cotton

The results related to Manganese uptake in Bt cotton influenced by coated fertilizer are given in Table 4.33 and Fig 4.13.

**Table 4.33: Effect of coated fertilizer on manganese uptake in Bt cotton after harvest of crop.**

Treatments	Mn uptake (g ha <sup>-1</sup> )		Total Mn uptake (g ha <sup>-1</sup> )
	Seed	Straw	
T <sub>1</sub> - Absolute control	22.75	193.76	216.50
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	38.36	230.68	269.04
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	80.34	276.28	356.62
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	63.51	265.15	328.66
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	68.01	267.70	335.71
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	53.67	260.75	314.42
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	46.15	263.07	309.22
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	38.56	256.00	294.56
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	49.62	258.98	308.60
<b>SE m±</b>	<b>0.51</b>	<b>3.27</b>	<b>13.69</b>
<b>CD at 5 %</b>	<b>1.53</b>	<b>9.80</b>	<b>41.05</b>
<b>CV</b>	<b>1.73</b>	<b>2.24</b>	<b>7.74</b>

The uptake of Manganese by seed and straw are calculated separately and total Manganese uptake by crop was calculated. The uptake of Manganese by seed, straw and total Mn uptake after harvest varied in the range of (22.75 to 80.34), (193.76 to 276.28) and (216.50 to 356.62) g ha<sup>-1</sup>.

The highest Manganese uptake was recorded with treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) in seed, straw and total uptake, followed by T<sub>5</sub>>T<sub>7</sub>>T<sub>4</sub>>T<sub>6</sub>>T<sub>8</sub>>T<sub>9</sub>, respectively. The lowest Mn uptake was observed in absolute control (T<sub>1</sub>). The data was found statistically significant. Our results are similar to the findings of Namdev *et al.* (1992), they recorded the foliar spraying of 1% Micnelf (containing Fe, Mn, Cu, Zn, Mo, and B) highest content and uptake of micronutrient.

#### **4.7.7 Copper uptake in Bt cotton**

The results related to Copper uptake in Bt cotton influenced by coated fertilizer are given in Table 4.34 and Fig 4.13. The uptake of Copper by seed and straw are calculated separately and total Copper uptake by crop was calculated. The uptake of Copper by seed, straw and total Cu uptake after harvest varied in the range of (5.86 to 30.50), (34.73 to 85.07) and (40.59 to 115.57) g ha<sup>-1</sup>.

The highest Copper uptake was recorded with treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) in seed, straw and total uptake, followed by T<sub>5</sub>>T<sub>7</sub>>T<sub>4</sub>>T<sub>6</sub>>T<sub>8</sub>>T<sub>9</sub>, respectively. The lowest Cu uptake was observed in absolute control (T<sub>1</sub>). The data was found statistically significant. Our results are similar to the findings of Namdev *et al.* (1992), they recorded the foliar spraying of 1% Micnelf (containing Fe, Mn, Cu, Zn, Mo, and B) highest content and uptake of micronutrient.

**Table 4.34: Effect of coated fertilizer on copper uptake in Bt cotton after harvest of crop.**

Treatments	Cu uptake (g ha <sup>-1</sup> )		Total Cu uptake (g ha <sup>-1</sup> )
	Seed	Straw	
T <sub>1</sub> - Absolute control	5.86	34.73	40.59
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	11.76	46.19	57.95
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	30.50	85.07	115.57
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	24.17	78.81	102.98
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	26.88	80.51	107.39
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	19.59	75.62	95.21
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	18.23	78.12	96.35
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	14.25	68.25	82.50
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	17.85	57.73	75.58
<b>SE m±</b>	<b>0.54</b>	<b>1.95</b>	<b>1.82</b>
<b>CD at 5 %</b>	<b>1.63</b>	<b>5.86</b>	<b>5.46</b>
<b>CV</b>	<b>5.03</b>	<b>5.04</b>	<b>3.63</b>

The uptake of Copper by seed and straw are calculated separately and total Copper uptake by crop was calculated. The uptake of Copper by seed, straw and total Cu uptake after harvest varied in the range of (5.86 to 30.50), (34.73 to 85.07) and (40.59 to 115.57) g ha<sup>-1</sup>. The highest Copper uptake was recorded with treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) in seed, straw and total uptake, followed by T<sub>5</sub>>T<sub>7</sub>>T<sub>4</sub>>T<sub>6</sub>>T<sub>8</sub>>T<sub>9</sub>, respectively. The lowest Cu uptake was observed in absolute control (T<sub>1</sub>). The data was found statistically significant. Our results are similar to the findings of Namdev *et al.* (1992), they recorded the foliar spraying of 1% Micnelf (containing Fe, Mn, Cu, Zn, Mo, and B) highest content and uptake of micronutrient.

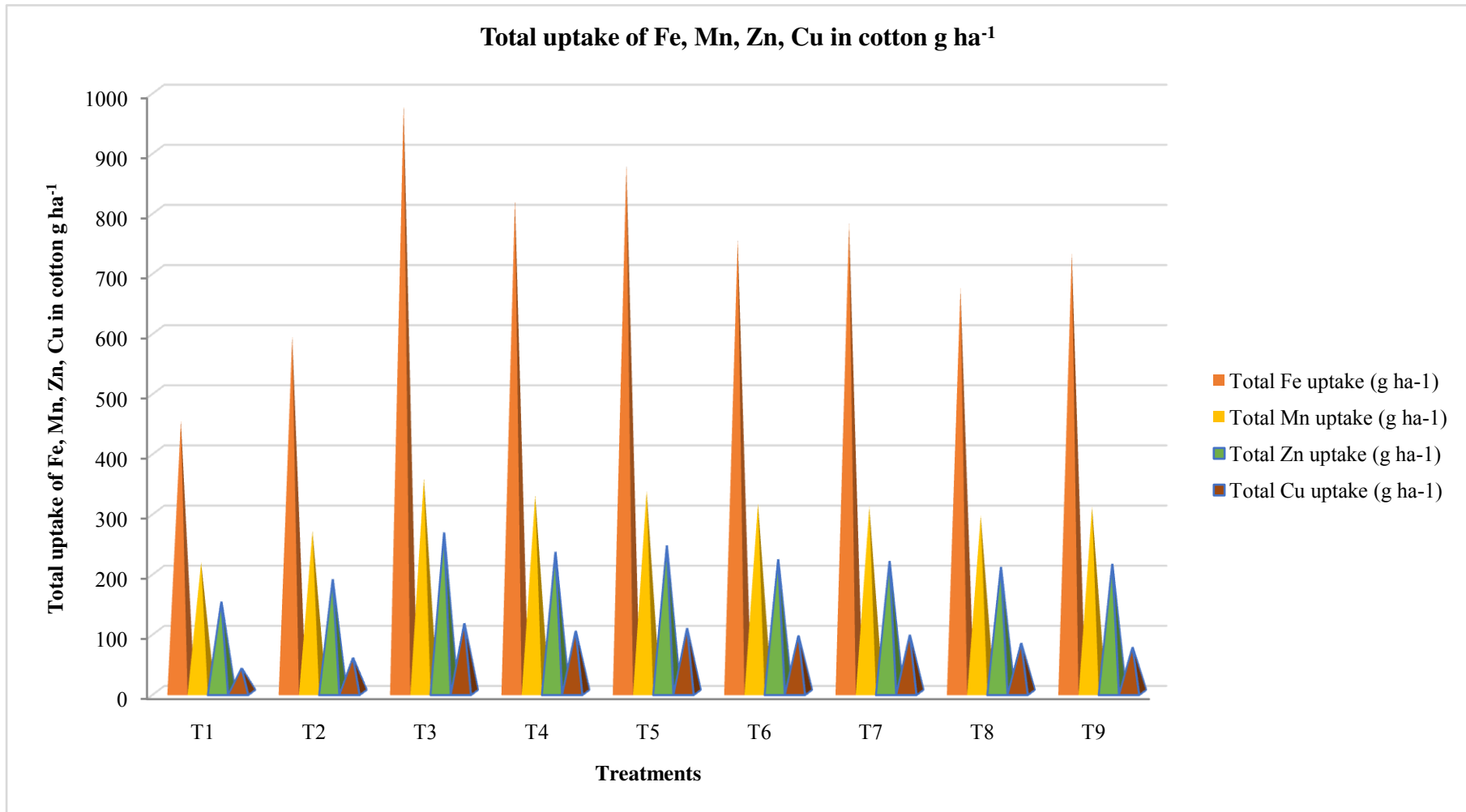
#### 4.7.8 Zinc uptake in Bt cotton

The results related to Zinc uptake in Bt cotton influenced by coated fertilizer are given in Table 4.35 and Fig 4.13.

**Table 4.35: Effect of coated fertilizer on zinc uptake in Bt cotton after harvest of crop.**

Treatments	Zn uptake (g ha <sup>-1</sup> )		Total Zn uptake (g ha <sup>-1</sup> )
	Seed	Straw	
T <sub>1</sub> - Absolute control	16.98	134.84	151.52
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	29.73	159.06	188.79
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	75.01	191.50	266.51
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	55.69	178.50	234.19
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	63.82	181.18	245.00
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	45.82	176.07	221.89
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	43.67	175.41	219.08
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	35.72	173.53	209.25
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	40.22	174.25	214.47
<b>SE m±</b>	<b>1.59</b>	<b>1.45</b>	<b>2.22</b>
<b>CD at 5 %</b>	<b>4.78</b>	<b>4.36</b>	<b>6.67</b>
<b>CV</b>	<b>6.12</b>	<b>1.47</b>	<b>1.78</b>

The uptake of Zinc by seed and straw are calculated separately and total Zinc uptake by crop was calculated. The uptake of Zinc by seed, straw and total Zn uptake after harvest varied in the range of (16.98 to 75.01), (134.84 to 191.50) and (151.52 to 266.51) g ha<sup>-1</sup>. The highest Zinc uptake was recorded with treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) in seed, straw and total uptake, followed by T<sub>5</sub>>T<sub>7</sub>>T<sub>4</sub>>T<sub>6</sub>>T<sub>8</sub>>T<sub>9</sub>, respectively. The lowest Zn uptake was observed in absolute control (T<sub>1</sub>). The data was found statistically significant. Our results are similar to the findings of Namdev *et al.* (1992), they recorded the foliar spraying of



**Fig. 4.13 Effect of coated fertilizer on total uptake of Fe, Mn, Zn and Cu of Bt cotton.**

1% Micelf (containing Fe, Mn, Cu, Zn, Mo, and B) highest content and uptake of micronutrient.

#### 4.8 Effect of coated fertilizer on nutrient use efficiency in cotton crop.

Partial factor productivity a measure of nutrient use efficiency was calculated by using economic yield ana biological yield divided by nutrient applied (Table 4.36). The partial factor productivity was highest in T<sub>7</sub> i.e., 50% reduction to RDF with coated fertilizer followed by T<sub>8</sub>>T<sub>3</sub>>T<sub>5</sub>. Our results are related to findings of Ghafoor *et al.* (2021) the results show that, the positive effect of coated fertilizers was found on growth, development, physiological, yield and PFP in wheat crop.

**Table 4.36: Effect of coated fertilizer on nutrient use efficiency (partial factor productivity, agronomic efficiency and apparent nutrient recovery) in cotton crop.**

Treatments	Nutrient Use Efficiency		
	Partial factor productivity (Kg Kg <sup>-1</sup> )	Agronomic efficiency (Kg Kg <sup>-1</sup> )	Apparent nutrient recovery (%)
T <sub>1</sub> - Absolute control	-	-	-
T <sub>2</sub> - Recommended dose of fertilizer (Through straight fertilizer)	13.15	2.14	7.21
T <sub>3</sub> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	18.97	4.63	32.52
T <sub>4</sub> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	16.71	4.45	18.28
T <sub>5</sub> -25% reduction to RDF with coated fertilizer grade	23.52	7.17	29.43
T <sub>6</sub> - 25% reduction to RDF with non-coated fertilizer	20.96	4.62	22.23
T <sub>7</sub> - 50% reduction to RDF with coated fertilizer	30.47	5.94	30.07
T <sub>8</sub> -50% reduction to RDF with non-coated fertilizer	29.97	5.45	21.67
T <sub>9</sub> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	15.43	3.17	13.12
<b>SE m±</b>	<b>0.29</b>	<b>0.17</b>	<b>0.28</b>
<b>CD at 5 %</b>	<b>0.90</b>	<b>0.53</b>	<b>0.87</b>
<b>CV</b>	<b>2.44</b>	<b>6.56</b>	<b>2.30</b>

Agronomic efficiency a measure of nutrient use efficiency was calculated by using yield of fertilized plot minus yield of control plot and divided by nutrient applied (Table 4.36). The agronomic efficiency was highest in T<sub>7</sub> *i.e.*, 50% reduction to RDF with coated fertilizer followed by T<sub>8</sub>>T<sub>3</sub>>T<sub>5</sub>. Our results are similar to findings of Tesfay and Girmay, (2019) the results are show that the combine agronomic efficiency was found less as compared to individual nutrient agronomic efficiency.

Apparent nutrient recovery a measure of nutrient use efficiency was calculated by using standard formulae (Table 4.36). The apparent nutrient recovery was highest in in T<sub>7</sub> *i.e.*, 50% reduction to RDF with coated fertilizer followed by T<sub>8</sub>>T<sub>3</sub>>T<sub>5</sub>. Our results are related to findings of Noor *et al.* (2017).

#### **4.9 Effect of coated fertilizer on economics of cotton crop.**

Effect of coated fertilizer on economics of cotton presented in Table 4.37. Data showed that the highest gross return noticed with treatment (T<sub>3</sub>) receiving RDF through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) followed by T<sub>5</sub>>T<sub>7</sub>. The benefit cost ratio varied from Rs 1.19 to 2.20. the highest benefit cost ratio observed in treatment (T<sub>3</sub>), receiving RDF (120:60:60 Kg NPK ha<sup>-1</sup>) through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) followed by T<sub>5</sub>>T<sub>7</sub>. Our results are corresponds to Niranjana *et al.* (2017) the results are show that the impact of neem coated urea was found to be highly significant in soyabean as compared to the normal in terms of economic returns.

**Table 4.37: Effect of coated fertilizer on economics of cotton crop.**

<b>Treatment</b>	<b>Cost of cultivation (Rs ha<sup>-1</sup>)</b>	<b>GMR (Rs ha<sup>-1</sup>)</b>	<b>NMR (Rs ha<sup>-1</sup>)</b>	<b>B:C Ratio</b>
<b>T<sub>1</sub></b> - Absolute control	46185	55328	9142.50	1.19
<b>T<sub>2</sub></b> - Recommended dose of fertilizer (Through straight fertilizer)	61222	89856	28634	1.46
<b>T<sub>3</sub></b> - RDF through coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	78602	173368	94766	2.20
<b>T<sub>4</sub></b> - RDF through non-coated fertilizer grade (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	68705	141752	73046	2.06
<b>T<sub>5</sub></b> - 25% reduction to RDF with coated fertilizer grade	73052	150072	77020	2.05
<b>T<sub>6</sub></b> - 25% reduction to RDF with non-coated fertilizer	62937	121784	58846	1.93
<b>T<sub>7</sub></b> - 50% reduction to RDF with coated fertilizer	60207	105560	45353	1.75
<b>T<sub>8</sub></b> -50% reduction to RDF with non-coated fertilizer	55002	89128	34125	1.62
<b>T<sub>9</sub></b> - RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	64025	113672	49646	1.77

**CHAPTER -V**  
**SUMMARY AND CONCLUSION**

## CHAPTER - V

### SUMMARY AND CONCLUSION

A field experiment on “Studies on efficacy of coated fertilizer on soil properties, yield and quality of Bt cotton” was conducted at experimental farm of Department of Soil Science and Agril. Chemistry, Marathwada Krishi Vidyapeeth, Parbhani during *Kharif* 2021-2022. The experiment was laid out in Randomised Block Design with nine treatment and three replications in Vertisols. The soil samples were collected before sowing and at harvest stage of crop and plant samples were analyzed for their nutrient content by going through standard procedures.

The research findings emanating from these studies are briefly summarized below.

Initial soil characteristics revealed that soils had a slightly alkaline reaction, normal salt concentration, low levels of organic carbon, and were naturally calcareous. In addition to having a high potassium level and a medium sulphur content, the available nitrogen and phosphorus were low and medium, respectively. The soil is deficient in zinc and sufficient in Fe, Cu, and Mn.

The growth parameter like Plant height, number of monopodial branches, number of sympodial branches, days to 50% flowering, SPAD values, number of bolls per plant showed significantly maximum with treatment (T<sub>3</sub>) receiving RDF through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) at respective growth stages.

The yield parameter like seed cotton yield, dry matter yield, mean boll weight, test weight showed significantly highest in treatment (T<sub>3</sub>) receiving RDF through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) respectively.

The quality parameter like ginning percentage, lint index, staple length showed maximum in treatment (T<sub>3</sub>) receiving RDF through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) and minimum in treatment (T<sub>1</sub>) *i.e.*, Absolute control.

The effect of coated fertilizer on soil pH, electrical conductivity, organic carbon and calcium carbonate at harvest stage of Bt cotton was non-significant. The

nitrogen, phosphorus, potassium, sulphur and DTPA extractable micronutrient (Fe, Mn, Zn, Cu) significantly influenced with in treatment (T<sub>3</sub>) receiving RDF through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) respectively.

The highest N, P, K and S concentration in seed and straw of Bt cotton was recorded with in treatment (T<sub>3</sub>) receiving RDF through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) whereas lowest concentration of these nutrients in seed and straw was observed in treatment (T<sub>1</sub>) *i.e.*, Absolute control.

The Fe, Mn, Zn, Cu concentration in seed and straw of Bt cotton were found maximum with the treatment (T<sub>3</sub>) receiving RDF through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) whereas minimum concentration of these nutrients in seed and straw was observed in treatment (T<sub>1</sub>) *i.e.*, Absolute control.

The nutrient uptake of Bt cotton was significantly enhanced with application of coated fertilizer grade. Application of fertilizer 100% RDF through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) showed highest value of N, P, K, S, Fe, Mn, Zn and Cu uptake in seed and straw and total uptake followed by treatment T<sub>5</sub>>T<sub>7</sub>>T<sub>4</sub>>T<sub>6</sub>>T<sub>9</sub> whereas lowest value was recorded in treatment (T<sub>1</sub>).

## **Conclusions**

From the results summarized in above following conclusions are drawn:

1. Application of fertilizer through 100% RDF through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B11:23:10:4:1.9:0.4:0.2) has significantly enhanced growth, yield and quality parameter of Bt cotton.
2. The availability of nutrients like N, P, K, S, Fe, Mn, Zn and Cu improved with the application of 100% RDF through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2).
3. The content and uptake of N, P, K, S, Fe, Mn, Zn and Cu were increased in treatment (T<sub>3</sub>) receiving RDF through coated fertilizer grade (N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2).

## **LITERATURE CITED**

## LITERATURE CITED

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# **APPENDIX**

## APPENDIX

**Weekly weather data recorded during the course of investigation at Agrometeorological Observatory Vasant Rao Naik Marathwada  
Krishi Vidyapeeth, Parbhani during the year 2020-21**

WK No.	Period	Rainfall (mm)	Temperature °C		Humidity (%)		EVP (mm)	BSS (Hrs.)	W.V. (kmph <sup>-1</sup> )
			Max.	Min.	Max.	Min.			
26	25-01 July 21	35.3	32.9	23.3	84	57	4.6	5.6	5.2
27	02-08 July 21	41.1	33.4	23.8	82	54	5.3	5.9	4.2
28	09-15 July 21	389.7	29.7	22.0	96	78	1.1	2.4	3.7
29	16-22 July 21	126.7	30.1	22.6	92	73	3.0	5.7	4.1
30	23-29 July 21	9.9	30.5	21.4	89	65	3.4	4.5	5.3
31	30-05 Aug 21	1.4	30.9	21.6	84	63	3.3	2.7	5.8
32	06-12 Aug 21	2.3	33.1	22.5	84	52	4.9	6.2	4.2
33	13-19 Aug 21	48.5	29.4	22.2	89	70	3.6	4.7	4.6
34	20-26 Aug 21	5.9	30.6	22.4	92	64	3.1	5.2	2.9
35	27-02 Sep 21	48.8	30.0	22.7	78	59	3.0	3.4	2.8
36	03-09 Sep 21	233.1	28.2	21.8	94	78	1.6	3.9	3.3
37	10-16 Sep 21	44.4	30.9	22.0	90	69	3.4	6.6	4.3
38	17-23 Sep 21	48.6	30.9	22.3	105	71	4.0	5.1	3.7
39	24-30 Sep 21	133.9	28.9	21.8	94	75	1.6	2.2	3.6

WK No.	Period	Rainfall (mm)	Temperature °C		Humidity (%)		EVP (mm)	BSS (Hrs.)	W.V. (kmph <sup>-1</sup> )
			Max.	Min.	Max.	Min.			
40	01-07 Oct 21	112.9	32.7	22.4	94	59	3.5	7.3	2.4
41	08-14 Oct 21	3.0	33.0	21.2	92	46	4.4	7.8	2.3
42	15-21 Oct 21	45.8	31.1	19.6	89	48	4.2	7.0	2.9
43	22-28 Oct 21	0.0	31.5	15.9	86	30	5.0	9.4	2.1
44	29-04 Nov 21	0.0	31.2	15.7	79	36	5.5	8.5	3.7
45	05-11 Nov 21	0.0	30.9	14.3	85	29	5.0	7.6	3.3
46	12-18 Nov 21	0.0	30.8	20.6	81	54	4.1	4.5	4.6
47	19-25 Nov 21	1.2	31.7	21.7	88	49	4.0	6.5	4.3
48	26-02 Dec 21	0.0	28.8	15.3	79	35	5.0	5.9	3.9
49	03-09 Dec 21	4.2	28.2	16.7	87.4	45.1	3.1	3.5	3.0
50	10-16 Dec 21	0.0	20.8	11.5	75.4	25.3	3.4	5.2	2.5
51	17-23 Dec 21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	24-31 Dec 21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Total Rainfall</b>		<b>1336.7 (mm)</b>							

# **CURRICULUM VITAE**

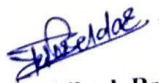
## CURRICULUM VITAE

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### Academic qualification

Course / Degree	Name of the college / institute	University / Board	Year of passing	Percentage (%) / CGPA	Class / Grade
SSC	Krantisingh Nana Patil Highschool, Sarade	Kolhapur	2013	79.60	Distinction
HSC	Tuljaram Chaturchand college, Baramati.	Pune	2015	64.77	I
B.Sc. (Agri)	College of Agriculture, Baramati.	MPKV, Rahuri	2020	82.00	I

Place : Parbhani  
Date : 30/12/2022

  
(Beldar Rushikesh Ramchandra)