# EFFECT OF SLOW RELEASE NITROGENOUS FERTILIZER ON YIELD, NUTRIENT UPTAKE AND QUALITY OF PRE SEASONAL SUGARCANE IN INCEPTISOL

by

**Mr. Zodge Ranuji Babasaheb**
(Reg. No.015/089)

**A thesis submitted to the**
**MAHATMA PHULE KRISHI VIDYAPEETH**
**RAHURI - 413 722, DIST.AHMEDNAGAR**
**MAHARSHTRA, INDIA**

In partial fulfillment of the requirements for the degree

of

**MASTER OF SCIENCE (AGRICULTURE)**

in

**SOIL SCIENCE AND AGRICULTURAL CHEMISTRY**

**DEPARTMENT OF SOIL SCIENCE AND AGRICULTURAL CHEMISTRY**
**POST GRADUATE INSTITUTE**
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**Approved by**

**Dr. A.D. Kadlag**
(Chairman and Research Guide)

**Dr. A.L. Pharande**
(Committee Member)

**Dr. S.R.Shelke**
(Committee Member)

**Dr. C.A. Nimbalkar**
(Committee Member)

**DEPARTMENT OF SOIL SCIENCE AND AGRICULTURAL CHEMISTRY**
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**MAHARASHTRA, INDIA**
**2018**

## CANDIDATE'S DECLARATION

I hereby declare that this thesis or part

There of has not been submitted

by me or other person to any

other University or Institute

for a Degree or

Diploma

Place:MPKV, Rahuri

Date://2018 (R.B. Zodge)

**Dr. A.D. Kadlag**
Soil Chemist (STCR) &
I/C Head
Department of Soil Science and
Agricultural Chemistry
Mahatma Phule KrishiVidyapeeth,
Rahuri – 413 722Dist. Ahmednagar,
Maharashtra, India

# CERTIFICATE

This is to certify that the thesis entitled, "**EFFECT OF SLOW RELEASE NITROGENOUS FERTILIZER ON YIELD, NUTRIENT UPTAKE AND QUALITY OF PRE SEASONAL SUGARCANE IN INCEPTISOL**", submitted to the Faculty of Agriculture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra) in partial fulfilment of the requirement for the award of the degree of **MASTER OF SCIENCE (AGRICULTURE)** in **SOIL SCIENCE AND AGRICULTURAL CHEMISTRY**, embodies the result of a piece of bonafide research work carried out by **MR. ZODGE RANUJI BABASAHEB** under my guidance and supervision and that no part of the thesis has been submitted for any other degree or diploma.

The assistance and help received during the course of this investigation have been duly acknowledged.

Place: M.P.K.V., Rahuri **(A.D. Kadlag)**
Date : / /2018 Chairman& Research Guide

**Dr. A.D. Kadlag**
Head
Department of Soil Science and
Agricultural Chemistry,
Mahatma PhuleKrishiVidyapeeth,
Rahuri – 413 722Dist. Ahmednagar,
Maharashtra, India

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Place: M.P.K.V., Rahuri **(A.D. Kadlag)**
Date : / /2018

**Dr. P.A. Turbatmat**
Associate Dean
Post Graduate Institute
Mahatma PhuleKrishiVidyapeeth,
Rahuri – 413 722Dist. Ahmednagar,
Maharashtra, India

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Place: M.P.K.V., Rahuri **(P.A. Turbatmat)**
Date : / /2018

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**Place :** M.P.K.V., Rahuri

**Date :** / /2018 (R.B. Zodge)

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# LIST OF ABBREVIATIONS

| | | |
|---|---|---|
| % | : | Per cent |
| Ca | : | Calcium |
| $CaCO_3$ | : | Calcium carbonate |
| CDU | : | Crotonylidenediurea |
| cm | : | Centimeters |
| $CO_3^{2-}$ | : | Carbonate |
| Cu | : | Copper |
| cv. | : | Cultivar |
| DAA | : | Days after application |
| DAP | : | Days after planting |
| $dSm^{-1}$ | : | DesiSimens per meter |
| DTPA | : | Diethylene triamine penta acetic acid |
| EC | : | Electrical conductivity |
| *et al.* | : | *Et alia*, and others |
| Fe | : | Iron |
| Fig. | : | Figure |
| FYM | : | Farm yard manure |
| g | : | Gram (s) |
| GRDF | : | General recommended dose of fertilizer |
| ha | : | Hectare |
| i.e. | : | That is |
| K | : | Potassium |
| $K_2O$ | : | Potassium oxide |
| kg $ha^{-1}$ | : | Kilogram per hectare |
| kg | : | Kilogram (s) |
| LGU | : | Large granular urea |
| m | : | Meter (s) |
| me $L^{-1}$ | : | Miliequivalent per liter |
| mg $kg^{-1}$ | : | Milligram per kilogram |
| Mg | : | Magnesium |
| mm | : | Millimeter |
| Mn | : | Manganese |
| MT | : | Metric tonne |
| N | : | Nitrogen |
| N.S. | : | Non significant |
| NCU | : | Neem coated urea |
| $NH_4^+$ | : | Ammonium ion |
| $NO_3^-$ | : | Nitrate ion |
| OC | : | Organic carbon |

| | | |
|---|---|---|
| P | : | Phosphorus |
| $P_2O_5$ | : | Phosphorus pentoxide |
| PCU | : | Polymer coated urea |
| pH | : | Puissance de hydrogen |
| S | : | Sulphur |
| S.E. | : | Standard error |
| SCU | : | Sulphur coated urea |
| SRF | : | Slow release fertilizers |
| t $ha^{-1}$ | : | Tonnes per hectare |
| UF | : | Urea formaldehyde |
| USG | : | Urea sulphur glanular |
| viz., | : | Vide licet, namely |
| Zn | : | Zinc |

# ABSTRACT

## EFFECT OF SLOW RELEASE NITROGENOUS FERTILIZER ON YIELD, NUTRIENT UPTAKE AND QUALITY OF PRE SEASONAL SUGARCANE IN INCEPTISOL

by

**MR. ZODGE RANUJI BABASAHEB**

A candidate for the degree

of

MASTER OF SCIENCE (AGRICULTURE)

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SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

2018

**Research Guide** : Dr. A.D. Kadlag

**Department**: Soil Science and Agricultural Chemistry

The field experiment entitled, "Effect of slow release nitrogenous fertilizer on yield, nutrient uptake and quality of pre seasonal sugarcane in Inceptisol" was Conducted during 2015-16 at Research Farm of Soil Test Crop Response Correlation Project. The laboratory incubation study was carried out simultaneously at Department of Soil Science and Agril. Chemistry, MPKV, Rahuri. Both experiments consist of eight treatments *viz*., GRDF, 80% RDF uncoated + Ag Rho N protect-B 0.3%, 80% RDF neem coated + Ag Rho N protect-B 0.3%, 80% RDF uncoated, 80% RDF uncoated + Ag Rho N protect-B, 0.2%, 80% RDF neem coated + Ag Rho N protect-B, 0.2%, 80% RDF neem coated and Absolute control. The randomized block design was used with three replications.

The general recommended dose of fertilizer at 7, 14, 21 and 30 DAA in an incubation study recorded significantly higher dehydrogenase enzyme activity (42.48, 38.91, 33.82 and 37.08 µg TPF $g^{-1}$ soil $hr^{-1}$ respectively) and urease enzyme activity (30.5, 23.47, 23.33 and 21.5 µg $NH_4$-N $g^{-1}$ soil 24 $hr^{-1}$ respectively). The ammonical nitrogen content was numerically increased with an increased incubation period upto 60 DAA. It was significantly higher in general recommended dose of fertilizer at all the period of incubation (40.19, 41.83, 42.78, 42.95, 43.36 and 44.07 µg $NH_4$-N $g^{-1}$ soil 24 $hr^{-1}$ respectively) over rest of the treatments.

The $NO_3$-N content was showed the similar trend to that of $NH_4$-N content but it was increased upto 45 DAA and decreased at 60 DAA. The soil available nitrogen was increased with an increased period of incubation upto 60 DAA. It was significantly higher at 60 DAA in treatment 80% RDF neem coated + Rho N protect-B 0.3% (71.07 µg $g^{-1}$ soil) followed by GRDF (66.89 µg $g^{-1}$ soil).

The yield contributing characters in field in respect to millable cane, height and total cane height was significantly higher in treatment 80% RDF neem coated + Ag Rho-N protect-B 0.3% (273.16 and 364.5 cm). The rest of the yield contributing character did not showe relation. The general recommended dose of fertilizer recorded significantly higher cane and commercial cane sugar yield (242.4 and 25.49 MT $ha^{-1}$) and total uptake of nitrogen, phosophorus and potassium (162.70, 45.39 and 98.94 kg $ha^{-1}$ respectively). It was followed by treatment 80% RDF neem coated + Ag Rho N protect-B 0.3% for cane and CCS yield (221.81 and 23.84 MT $ha^{-1}$).

The juice quality of preseasonal sugarcane was not influenced by the slow release nitrogenous fertilizers. The per cent sucrose content was significantly influenced over 80% RDF neem coated. Whereas, the rest of treatments were statistically on par with each other.

The residual soil fertility was significantly influenced by the slow release nitrogenous fertilizer to preseasonal sugarcane. The residual fertility built up was higher in general recommended dose of fertilizers. The soil metabolic activities in respect to residual dehydrogenase urease enzyme activity and bacterial population were significantly more in treatment GRDF followed by 80% RDF neem coated + Ag Rho N protect-B 0.3%.

Thus, the nitrogen management to preseasonal sugarcane as 80% RDF neem coated + Ag Rho N protect-B 0.3% or general recommended dose of fertilizer are beneficial to harvest higher cane and commercial cane sugar yield and maintain the residual soil fertility.

**Pages 1 to 42**

# 1. INTRODUCTION

Sugarcane is a subtropical crop which is botanically known as *Saccharum officinarum* (2n=80). It is very well known for its sugar content (sucrose). Most of the sugar obtained in world i.e. 60% is from sugarcane. Sucrose content of sugarcane is 20%. It has occupied 40.75 lakh ha area in India, while 7.36 lakh ha in Maharashtra state. Sugarcane is $C_4$ intermediate short day crop. It is long duration i.e. perennial *Saccharum officinarum* plant that undergoes a series of interdependent but fairly distinct growth phase during its life time. These phases are germination, tillering (together called formative phase), vegetative grand growth, flowering or tasseling and ripening or maturity. It is favourably adaptable to various soil conditions. Nitrogen is essential and primary nutrient, required by all the crops in large amount. However, nitrogen fertilizer added in soil get leached or washed out. It not only causes economic loss but also gives invitation to soil, water and environmental pollution. It causes harm to soil health as well as human health. The use of slow release fertilizer some extent useful and eco-friendly option to overcome these problems.

Fertilizer is a key input for sugarcane production as the crop is very responsive to higher fertilizer application. Due to this, increasing tendency among the farmers to use higher doses of chemical fertilizer (particularly nitrogenous fertilizers) for obtaining higher yields without any considerations and its ill effects on the physico-chemical properties of soil. It is well known fact, that organic sources of nutrients improve the physical, chemical and biological properties of soil. They also improve the efficiency of applied chemical fertilizer.

The present production of fertilizer nutrients of the country is not enough to meet the total plant nutrient requirement for the expected production. In recent year the imbalanced and inadequate fertilizer use coupled with low use efficiency of other inputs, has declined the response efficiency of slow release fertilizer nutrients under intensive agriculture system. The use of chemical fertilizers would remain the mainstay of agricultural production in future as well, given the increasing food demands of growing population and in sufficient food availability to feed around 1.4 billion populations. This would necessitate the use of about 45 million tonnes of nutrients.

Most of soils contain nutrients that are required by plants but the quantity and availability of such nutrients will vary with different soils depending upon their origin, composition and present use. The sufficiency of such nutrient stocks for crop production will depend upon the crop species and targeted output of the economic produce of that crop. So, the farmer has to find out how much of nutrients could be supplied by his farm soil for the crop to be grown by him and then determine how much he has to additionally supplement. The reasons for declining soil fertility being  the organic manure content in the soil and use of unbalanced fertilizers and not practicing the integrated use of slow release nitrogenous fertilizer.

Various studies in the country shows that neither the mineral fertilizers alone nor the only organic sources exclusively can achieve the production sustainability of soil and sugarcane under intensive cropping system. Integrated use of organic manures and chemical fertilizers can sustain sugarcane production (Banger and Sharma, 1997). To sustain the productivity of sugarcane and to maintain the fertility level of the soil, appropriate combinations to be marked out.

Urea is the widely used nitrogenous fertilizer in agriculture because of its high nitrogen content (46%). However, 50-70 per cent of the applied nitrogen lost due to different losses via volatilization & leaching, reducing the use efficiency of applied fertilizers (Shaviv and Mikkelsen, 1993). This reduces the productivity and increases the cost of cultivation besides polluting the environment. Increasing the nitrogen use efficiency will lead to increase in productivity . Various methods recommended to increase fertilizer use efficiency are increasing the organic matter content of soil through application of organic manures, split application of fertilizers and application of coated or slow release fertilizers. In this context, the controlled release technology by coating urea with different materials such as phosphor gypsum, sulphur, resin polymers, pine tree Kraft lignin and neem using different techniques of rotating drum, fluidized bed and spouted bed to increase the efficiency of urea fertilizer has been investigated (Shusherman and Anggoro, 2011). It was reported that the thickness of coating fertilizers, affects the release pattern of nitrogen from fertilizers.

Sugarcane being a very exhaustive and extracting crop, removes about 205 kg $ha^{-1}$ nitrogen for yielding a crop and for sustaining productivity. Nitrogen is replenished through chemical fertilizer @ 340 kg $ha^{-1}$ in sugarcane.

Nitrogenous fertilizer are highly soluble and leads to considerable losses under upland condition and nitrification losses under low land conditions. Efforts have therefore, been made to develop slow release nitrogen fertilizers. Use nitrification inhibitors to retard nitrification of applied $NH_3$ or urea-N and to reduce leaching and nitrification losses (Prasad, 2005). Sugarcane crop produces a heavy tonnage and tends to remove substantial quantum of plant nutrients from the soil. A cane crop producing the cane yield of 100 t $ha^{-1}$ removes about 208 kg N, 53 kg of P, 280 kg K, 3.4 kg Fe, 1.2kg Mn, 0.6 kg Zn and 0.2 kg Cu from soil (Yaduvanshi and Yadav, 1990). For achieving the higher cane yield , balanced use of fertilizer nutrients, is the important management factor of cultivation. Use of inorganic fertilizer alone cannot maintain the soil fertility and use of organic manures is inevitable for sustained agriculturalproduction. Slow release of nutrients from organics , could help a long duration sugarcane crop to take their complete benefit in one season.

A detailed economic analysis showed that chemical fertilizers alone would account for 22 to 25 per cent of the cost of sugarcane production . Mathukia and Srinivas (1999) reported that use of organic manures is inevitable for sustained agricultural production. Due to slow release of nutrients from organics, sugarcane a long duration crop can take its complete benefit. In view of this the present investigation was planned with the following objectives.

**Objectives**

1. To study the effect of slow release nitrogenous fertilizer on yield and nutrient uptake by preseasonal sugarcane.
2. To find out the effect of slow release nitrogenous fertilizer on juice quality of preseasonal sugarcane.
3. To assess the effect of slow release nitrogenous fertilizer on residual fertility at harvest of preseasonal sugarcane.

# 2. REVIEW OF LITERATURE

Soil is a living system where all biochemical activities proceed through enzymatic processes. Nutrient cycling in soils involves biochemical, chemical and physio-chemical reactions; with the biochemical process being mediated by microorganism, plant roots and soil animals. It is well known that all biochemical reaction is catalyzed by enzymes, which are proteins with catalytic properties owing to their power of specific activation. Enzymes accumulated in soils are present as free enzymes. Such as exoenzymes released from living cells endoenzymes released from disintegrating cells. Enzymes plays vital role in transformation, recycling and availably of various nutrients in soil. Among the soil enzymes urease, acid phosphatise and dehydrogenase are the extra cellular. The activities of these enzymes are likely influenced by fertilizers and manures. The pertinent research findings observed by the research scientists in relation to the research carried out in respect of slow release fertilizers on yield and quality of preseasonal sugarcane grown on inceptisol during recent past are reviewed in this chapter.

**Transformation of urea in soil**

Urea is an organic compound and dissociate in water. So it cannot be retained by negatively charged soil particles in the same manner as ammonium carbonate. Urea on application to the soil first undergoes hydrolysis resulting in the production of ammonia. Hydrolysis of urea is carried out by the enzyme urease. Since sufficient free acids and alkalies are not present in the soil,the rate of chemical hydrolysis of urea is very insignificant in comparison with biochemical hydrolysis. Thus, the hydrolysis of urea in the soil is mainly due to enzymatic activity of these urease. The soil is an excellent medium for the varied microbial population, which is capable of producing enzyme urease, responsible for the biochemical hydrolysis of urea in to ammonia. The ammonia so formed subsequently gets converted into nitrate.

## 2.1 Effect of slow release nitrogenous fertilizer on enzyme activity

### 2.1.1 Dehydrogenase enzyme activity

Goyal *et al*. (1992) reported the increase in dehydrogenase activity of sandy loam texture soil (*Typic Ustochrept*) with inorganic fertilizers and organic amendments. The highest dehydrogenase activity (218 mg TPF $g^{-1}$ soil 24 $hr^{-1}$) was recorded in the wheat straw amended soil than FYM amended soil (195 mg TPF $g^{-1}$ soil 24 $hr^{-1}$). Further, they were reported positive significant correlation among dehydrogenase activity and bacterial counts with microbial biomass carbon.

Perucci (1992) reported that soil dehydrogenase activity reflects the total range of oxidative activity of soil micro flora and is consequently used as indicator of microbial activity.

Singaram and Kamalakumari (1995) summarized from a long turn effect of FYM and fertilizers on activities of dehdrogenase in (*Typic Ustrostept*) reported that the dehdrogenase activity was maximum in FYM treatment. The higher rates of NPK fertilization enhanced the enzyme activity and effect was more pronounced with FYM in combination with fertilizer.

Goutami *et al.* (2015) showed that the soil dehydrogenase activity increased with addition of organic carbon through FYM. The dehydrogenase activity maximum at flowering (72.89 $mg^{-1}$ 24 $hr^{-1}$) and decline at time of harvest (49.78 $mg^{-1}$ 24 $hr^{-1}$) and highest when the treatment received combined application of 150 kg N $ha^{-1}$ + FYM + Biofertilizers.

**2.1.2 Urease enzyme activity**

Sonar and Kamire (1979) conducted laboratory incubation study and reported the application of urea to a *Vertic Ustropepts* soil released more $NH_4$–N and $NH_3^-$-N than with 25, 50 and 100 percent of urea-N replaced by neem cake or karanj cake. $NO_3^-$-N concentration continuously increased throughout the period of 60 days of incubation. The rate of mineralization to applied urea-N in the soil decreased with increase in the proportion of neem or karanj cake added, there by increasing the available urea –N over a longer time.

Sarkunan and Biddappa (1980) reported that in an incubation study the transformation of nitrogen from urea blended with coaltar, in moist soil the production of $NH_4^+$ and $NO_2^-$ increased, whereas, $NO_3^-$ formation was significantly inhibited, the study indicated that there is considerable scope for increasing efficiency of urea under moist aerobic situation by coating with neem cake or coaltar.

Lal *et al*. (1996) reported the maximum urease activity after 7 days of incubation which decreased after 15 days and again increased after 30 days and finally decreased after 45 days. Such variation could largely be due to changes in organic carbon content of soil.

Salam *et al.* (1999) observed the changes in enzymatic activities including urease and showed a significant relationship with the contents of soil organic C and total N.

Srinivas *et al.* (2004) conducted a pot culture experiment and laboratory incubation studies to evaluate the addition of different organic manures on soil urease activity using rice as a test crop on Vertisol at College of Agriculture, Hyderabad. They reported that the urease activity increased during the active growth period of rice. Among the organic manure FYM @ 10 t $ha^{-1}$ recorded the highest urease activity upto 60 days incubation.

Xiaoguang *et al.* (2004) showed that the soil urease activity in all treatments of slow release urea fertilizers was lower at the seeding stage compared with control treatment, but demonstrated an obvious increase during the jointing stage. Thereafter, no significant differences were found between treatments. Significant positive correlation was found between soil urease activity and soil $NH_4^+$-N content.

The studies on nitrogen fertilizer in the form of urea is subject to ammonia volatilization through the activity of the urease enzyme found ubiquitously in the soil. Nitrogen volatilization is especially prevalent when urea is applied to the soil surface, as in no till systems when growers have not invested in sub-surface application tools. To decrease possible ammonia volatilization losses a number of slow release products have been developed to delay urease activity (Kissel *et al.*, 2008).

Sanz-Cobena *et al*. (2008) reported urease inhibitors compounds effectively abate $NH_3$ emissions by slowing the hydrolysis of urea, which limits the pool of $NH_4^+$ potentially lost through volatilization.

Aggarwal *et al.* (2015) reported that the urease enzyme is responsible for the hydrolysis of urea fertilizers applied to the soil in to $NH_3$ and $CO_2$ with rise in soil pH.

**2.2 Effect of slow release nitrogenous fertilizers on microbial population**

Choukesey *et al.* (1993) reported that the application of recommended doses of NPK along with FYM 15 t $ha^{-1}$ resulted into significantly higher population of bacteria ($95.25 \times 10^7$ cfu $g^{-1}$ soil) over all other treatment. Malewar *et al*. (1999) studied the $CO_2$ evaluation and microbial population in soil as influenced by organic and NPK fertilizers under sorghum-wheat system at MAU, Parbhani during 1994 to 1996 on *Typic Haplusterts.* They indicated the higher population of microbes with 50:50 inorganic + organic combinations. The conjoint application of organic manure along with fertilizers were able to enhance the microbial population rather fertilizer alone.

Selvi *et al*. (2004) reported that the population of bacteria, fungi and actinomycets were proliferated well under continuous application of NKP and FYM.

Xiaoguang *et al.* (2004) showed that the population of bacteria, fungi and actinomycets were proliferated well under continuous application of NPK and FYM.

Chang *et al.* (2006) showed that the populations of bacteria in the soil amended with compost were 1.68 fold higher than those in the CF treatment and increased with increases in the compost application rates.

Goutami *et al.* (2015) showed that the maximum bacterial population and urease activity ($10.6 \times 10^6$ cfu $g^{-1}$ soil and 19.8 µg $NH_4^+$-N $g^{-1}$ respectively) and decline at time of harvest ($8.8 \times 10^6$ cfu $g^{-1}$ soil and 15.4 µg $NH_4^+$-N $g^{-1}$ $hr^{-1}$) with increased rate of nitrogen application with FYM.

**2.3 Effect of slow release fertilizers on yield attributing characters, nutrient uptake and yield**

**2.3.1 Effect of slow release nitrogenous fertilizer on yield attributing characters**

The application of nitrogen has been reported to increase the tillering in sugarcane (Srinivasan and Mariakulandi, 1969; Tripathi and Jaiswal, 1974; Gill and Singh, 1976; Sugumaran *et al.,* 1976; Virendra Kumar, 1976; Narwal and Behl, 1979 and Naidu *et al.* (1982). The tillering increased with increased in the level of nitrogen upto 227 kg $ha^{-1}$ (Gahlot, 1954, Kirtikar and Anant Nath, 1964 and Alam and Majid, 1993) and then decreased with higher levels

(Mathur, 1972 and Panwar *et al* . 1980) . The application of N+P (Srivastava *et al* ., 1987) had significant effect on number of tillers per hectare. While application of USG at the rate of 225 kg N $ha^{-1}$ gave slightly more tillers than other rates and sources of nitrogen (Jayabal *et al.,* 1989). While Kadam (1986) reported that USG recorded more tillers than prilled urea.

Guttani *et al.* (1976) concluded that if nitrogenous fertilizers are used in combination with P, K and FYM, higher yield could be obtained without causing any deterioration of soil physical properties.

Katti *et al.* (1976) reported that increased height, straw yield, effective tillers per hill, number of grains per panicle and 100 grain weight were obtained with the application of 100 kg as urea indicating the beneficial effect of neem cake blended urea.

Oommen *et al.* (1977) reported that the highest percentage of productive tillers was recorded by neem cake blended urea. Thousand grain weight, yield of grain and straw were maximum in AM treated urea, followed by neem cake blended urea.

Allen (1986) showed that using slow release N fertilizers was preferable than using the fast soluble ones in improving growth, nutritional status, yield and quality of fruits.

Patil (1989) conducted a field experiment to study the effect of levels of neem extract coated urea on yield and nutrient uptake of upland rice and found that 120 kg N $ha^{-1}$ through neem extract coated urea increased grain yield and uptake of nitrogen by rice grown under upland conditions.

Soni and Kaur (1989) reported that the higher grain yield with slow release fertilizers in rice–rice system .

Ram (1999) reported that the maximum increase in plant height of guava tree in 1993 and 1994 was recorded with 600 g neem-coated urea, which was 5 and 19% and stem girth also increased significantly with 600 g neem coated urea in both the years.

Palled and Shenoy (2006) reported that the growth parameters, *viz*., plant height, number of leaves per plant, leaf area, fresh and dry weight per plant and chlorophyll content were significantly higher with the application of nitrogen through neem coated urea than the granular urea and prilled urea. This may be due to the fact that coating of urea decreases transformation of urea nitrogen and the leaching losses and provide more nitrogen to the plant.

Zaman *et al.* (2009) reported that the encapsulating of urea with inhibitors improved N availability and increased the crop yield. They also observed that the efficiency of both nitrification and urea inhibitors in soils is very much dependent on the water filled pore space of the soil during the period after application.

Kandil *et al.* (2010) showed that the supplying the tree of “MitGhamr” peach with the three slow release N fertilizers were superior to the application of the fast one in improving shoot length, leaf area, percentage of leaf N, as well as physical and chemical characteristics of fruits.

### 2.3.2 Effect of slow release nitrogenous fertilizers on nutrient uptake

Shankar and Ram (1976) reported that at 60 to 90 kg N, increased potassium uptake where greater with urea alone than with neem cake blended urea in paddy.

Nijjiar (1985) and Allen (1986) studied the great reduction in N loss and the increase in plant uptake of N due to the application of slow release N fertilizers could explain their effect in improving the leaf content of N.

Muneshwar and Singh (1986) reported that the neem cake blended urea reduces the leaching loss of $NO_3$-N and $NH_4^+$-N. Significant increase in the nitrogen concentration and uptake by the grains and straw, were observed on application of neem cake blended urea as compared with the urea alone.

Patil (1989) reported the higher N uptake by grain straw due to neem extract coated urea and urea super granules than basal application of prilled urea.

Koshino (1993) observed controlled release fertilizers improve the uptake of nutrients by plants through synchronized nutrient release, and significantly reduce possible losses of nutrients, particularly of nitrate–N by leaching and volatilization losses of ammonia. This substantially decreases risk of environmental pollution. Similar results here also reported by Ma *et al.* (2007).

### 2.3.3 Effect of slow release nitrogenous fertilizers on cane and commercial cane sugar yield

The blending of urea with USG and neem cake with urea (Ahmed *et al.,* 1987) gave higher yield of sugar than the urea alone. Application of USG at the rate of 210 kg N ha$^{-1}$ (Pandian and Kannappan, 1988), at the rate of 225 kg N ha$^{-1}$ (Jayabal *et al.*, 1989) and up to 30 kg N ha$^{-1}$ (Bangar and Sharma, 1997) gave better performance in terms of CCS yield.

The application of N through USG at the rate of 200 N ha$^{-1}$ placed at 10 to 15 cm depth was reported to be as effective as 275 kg ha$^{-1}$ of prilled urea applied by top dressing on soil surface (Nasir Ahmed *et al.,* 1992). While, application of nitrogen through USG at the rate of 75 per cent of recommended dose produced more or less same CCS yield in comparison with full dose of N through urea with two equal splits at 10 cm depth (Kadam, 1986; Kadam *et al.,* 1991 and Singh and Mishra, 1993). While application of N at 15 cm depth on one side either 30 cm distance or 45 cm in a line found significantly superior to broadcasting in respect of CCS yield (Londhe, 1982). Half dose of N and K at planting and remaining half dose at 120 days after planting gave significantly higher sugar yield than entire quantity at planting (Choudhary *et al.,* 1982) and 50 per cent N at the start of tillering and remaining 50 per cent at earthing up found to be optimum for higher sugar yield (Salunkhe *et al.*, 1980 and 1981).

### 2.3.4 Effect of slow release nitrogenous fertilizers on juice quality of preseasonal sugarcane

Panwar *et al.* (1980) observed that increasing level of N from 75 to 225 kg ha$^{-1}$ CCS per cent in cane juice was decreased.

However, Nasir Ahmed *et al.* (1992) found that N used either as USG at the rate of 200 kg ha$^{-1}$ (12.46%) placed at 10 cm depth or as prilled urea at the rate of 275 kg ha$^{-1}$ (12.47%) were equally effective in respect of CCS (%).

Singh *et al*. (1983) reported that the significantly higher sucrose in juice in the treatment of neem cake blended urea and USG than prilled urea. Whereas, sucrose content in juice was not affected significantly with USG and PU (Singh and Mishra, 1993).

Ram (1999) reported that there was the highest fruit quality of guava with 600 g neem–coated urea which was significantly higher than with all the other treatments and the control and also improved T.S.S. and reducing and non reducing sugars with application of slow releasing fertilizers.

Kandil *et al.* (2010) showed that the application of three slow release N fertilizers (UF, PCU, SCU) increasing the total soluble solids and total sugar, reducing and non reducing sugars as compared to through urea at the same higher levels.

Devashi (2012) reported that the higher quality parameters such as reducing sugars and total sugars content (5.02 and 7.10 %, respectively) were obtained in the treatment with 900 g N tree$^{-1}$ in which 25% N was from urea and 75% N from castor cake.

## 2.4 Effect of slow release nitrogenous fertilizers on residual fertility

### 2.4.1 pH and EC

Dixit and Gupta (2000) observed that there was little variation in the soil pH of inceptisol which ranged from 7.70 to 7.80 under different NPK combinations along with FYM, blue green algae as against initial soil pH 7.8.

Eghball (2002) found that the surface soil (0-15 cm) pH and EC significantly increased with N based manure or compost application but decreased with $NH_4$-N fertilizer application.

### 2.4.2 Soil available nitrogen

Naik and Ballal (1968) carried out an incubation study in medium black soils applied with various levels of organic matter, FYM and nitrogen through ammonium sulphate alone and in combination. These results slowed that the availability of nitrogen increased at 0.5 to 1.0% level of organic matter addition. The availability of potassium increased at all levels of organic matter addition. The organic matter added to the soil act as inhibitor in early stage and later on releases the nitrogen slowly to crops.

Bhuyia *et al.* (1974) during incubation study noticed that the application of urea to non calcareous dark grey flood plain soils increased the $NH_4$-N up to two weeks and to brown hill soil up to first week. The $NO_3$-N concentration of soil increased with increasing incubation time. The $NH_4$-N and $NO_3$-N of the soils increased with increasing rates of applied urea-N.

Santhy *et al.* (1998) found the effect on build up all organic N fractions with the application of FYM along with the inorganic fertilizers.

Prakash *et al.* (2002) reported that the availability of major nutrients was higher in the treatment with organic nutrient sources like FYM, vermicompost and FYM + microbial cultures as compared to inorganic fertilizers.

Dahiya *et al.* (2004) showed that the slow release fertilizers (UF, SCU, PCU) are slow acting and facilitate long term availability of the N, P, K nutrients often synchronized with the physiological need of plants and are considered as one of the most viable alternative for the sustainable plant productivity.

Sharma and Singh (2010) reported that the ammonium was available for longer duration that synchronized with the nitrogen demand of the *Brassica* plants due to the slow release property of organic matrix based SRF granules.

### 2.4.3 Soil available phosphorus

Gaur *et al*. (1984) reported the manure block specific adsorption sites and forms organic P compounds in the manure, which is subsequently mineralized, when added to the soil. The increase in uptake of P with increase in FYM and NPK treatment may be attributed to P solublization by P solubilising bacteria from the organic FYM source.

Tiwari *et al.* (2002) studied the use of recommended dose of fertilizer with FYM resulted in an increase in the available phosphorus content of soil (39.40 kg P $ha^{-1}$). They indicated that the integrating fertilizers with manure could enhance the available P content of soil.

Sali *et al.* (2003) reported significantly higher (9.1 $kg^{-1}$) phosphorus availability in mineral fertilizer and organic mulch under banana cultivation.

Tolanur and Badanur (2003) observed that available phosphorus content of soil was increased significantly with FYM. Increased available phosphorus, might be because of solubilisation of the native phosphorus in the soil through release of various organic acids.

### 2.4.4 Soil available potassium

Mathur (1997) studied the long term effect of application of fertilizers and manures on soil properties under cotton – wheat rotation on sandy loam soil. They reported that full dose of FYM [100% FYM ( 0.5% N) was applied @ 16 and 24 t $ha^{-1}$ for cotton and wheat respectively recorded significantly higher availability of K (630 kg $ha^{-1}$), which was followed by 50% FYM + 50% NPK (552.5 kg $ha^{-1}$).

Santhy *et al.* (1998) studied the long-term (1982-1992) effect of continuous cropping and fertilization on sandy clay loam soil at Coimbatore. They reported that available K content of the soil was increased (765, 605 and 590 kg $ha^{-1}$ in 1982, 1987 and 1992 respectively) over the initial value (490 kg $ha^{-1}$) under 100% NPK + FYM treatment.

Suresh and Hasan (2002) reported noticeable change in available soil K due to the application of different levels of N and K in banana crop. They recorded highest soil available K at vegetative stage and thereafter, it decreased gradually during shooting stage and harvest.

### 2.4.5 Soil available micronutrients

Prasad and Singh (1980) showed significant effect of manuring and cropping on available micronutrient status of the soil. Available Zn, Cu, Fe, Mn increased considerably with continuous use of chemical fertilizers and particularly with FYM containing 40, 3, 39 and 140 ppm of Zn, Cu, Mn and Fe, respectively seen to have contributed towards improving the micronutrient status.

Bellakki and Badanur (1997) concluded that incorporation of organic sources of nutrients either alone or in combination with fertilizers recorded higher DTPA- extractable micronutrients (ZN, Fe, Mn, and Cu) in surface and sub-surface soils. Addition of organic manure might enhanced the microbial activity in the soil and consequent release of complex organic substances could have prevented micronutrients from precipitation, fixation, oxidation and leaching. Application of recommended NPK along with FYM 10t $ha^{-1}$ significantly increased the available DTPA- Zn and Mn over inorganic fertilizers.

Anand Swarup and Yaduvanshi (2000) reported that the available DTPA-Zn and Mn was increased to 0.92 mg $kg^{-1}$ and 3.7 mg $kg^{-1}$ as compared to initial value 0.80 mg $kg^{-1}$ with application of FYM with NPK fertilizers respectively.

Mukhopadhyay and Das (2001) recorded the higher amount of extractable Fe and Mn in inceptisol and alfisol with the application of organic matter. The magnitude was more with the levels of organic matter indicated its positive relationship with the extractability of Fe and Mn in the soils.

# 3. MATERIAL AND METHODS

The present investigation was carried out by conducting a field experiment entitled, “Effect of slow release nitrogenous fertilizer on yield, nutrient uptake and quality of preseasonal sugarcane in Inceptisol”. The details of material used, experimentation and analytical techniques adopted for this investigation are presented in this chapter.

## 3.1 Location

Geographically the central campus of Mahatma Phule Krishi Vidyapeeth, Rahuri is situated 38 km from Ahmednagar, on Ahmednagar-Manmad State Highway. It lies between $19^0$ 48’ N to $19^0$ 57’ N latitude and $74^0$ 19’ E longitude. The altitude varies from 495 to 569 meters above mean sea level. This tract is lying on the Eastern side of Western ghat, under scarcity zone.

## 3.2 Climatic conditions

### 3.2.1 General

Climatologically it falls in semi-arid tropics with an rainfall varying from 307 to 619 mm. The annual precipitation is 520 mm. Out the total annual rainfall, about 80 per cent rains are received from South – West monsoon (June to September) while, rest received from North-West monsoon. The number of rainy days varies from 15-45 days in a year. The mean annual maximum and minimum temperature ranged from 41.2 to $28.3^0$C and 25.3 to $8^0$C respectively. The relative humidity during morning and evening hours ranged between 86.3 – 30.6 per cent and 77.1 - 16.9 per cent, respectively. The meteorological data recorded during experimental crop growth are presented in Table 3.1.

### 3.2.2 Season during experimental period

The experiment was conducted in pre-seasonal season of 2015-2016 and weekly meteorological data during experimental period regarding maximum and minimum temperature, morning and evening humidity are given in Table 1.

### 3.2.3 Soils

Soils of experimental field was slightly alkaline in reaction with soluble salts (EC) of 0.39 $dSm^{-1}$. Soil available nitrogen and phosphorus content was medium (204 and 18 kg $ha^{-1}$) and potassium was high (320 kg $ha^{-1}$). The soil available iron, manganese, zinc and copper content were in sufficient range (8.21, 14.50, 0.61 and 4.43 µg $g^{-1}$ respectively).

**Table 3.1 Meteorological data during 2015-2016**

| Month | Met. Week | Temperature ($^0C$) | | Relative humidity (%) | | Wind velocity ($kmhr^{-1}$) | Rain fall (mm) | Rainy days | Sun shine hrs. |
|---|---|---|---|---|---|---|---|---|---|
| | | Max. | Min. | Morn. | Even. | | | | |
| Dec. 2015 | 49 | 33 | 14 | 59 | 33 | 0.5 | 9.4 | 0 | 0 |
| | 50 | 32 | 16 | 49 | 33 | 0.7 | 9.0 | 0 | 0 |
| | 51 | 31 | 14 | 64 | 36 | 0.4 | 8.6 | 0 | 0 |
| | 52 | 29 | 8 | 43 | 22 | 1.3 | 9.3 | 0 | 0 |
| Jan. 2016 | 1 | 37 | 12.7 | 52 | 40 | 0.8 | 0 | 0 | 8.2 |
| | 2 | 32 | 10.7 | 62 | 55 | 0.2 | 0 | 0 | 8.4 |
| | 3 | 33 | 8 | 54 | 32 | 1.6 | 0 | 0 | 9.1 |
| | 4 | 37.2 | 12 | 51 | 24 | 1.1 | 0 | 0 | 9.5 |
| Feb. | 5 | 41 | 16.8 | 54 | 25 | 0.9 | 0 | 0 | 10.3 |
| | 6 | 38.6 | 14.8 | 65 | 26 | 0.7 | 0 | 0 | 11.3 |
| | 7 | 32.3 | 19.5 | 67 | 23 | 7.6 | 0 | 0 | 12.4 |
| | 8 | 31.6 | 16.1 | 70 | 39 | 8.2 | 0 | 0 | 9.5 |
| March | 9 | 30.2 | 12.8 | 67 | 52 | 2.8 | 0 | 0 | 6.8 |
| | 10 | 35.3 | 19.2 | 59.9 | 32.8 | 1.1 | 1.3 | 0 | 7.4 |
| | 11 | 34.5 | 17.1 | 51.4 | 21.9 | 0.8 | 0 | 0 | 8.1 |
| | 12 | 35.9 | 17.3 | 40.1 | 19.9 | 1.2 | 0 | 0 | 9.2 |
| | 13 | 37.1 | 18.8 | 34.9 | 17.3 | 2.7 | 0 | 0 | 9.1 |
| April | 14 | 39 | 19.4 | 40.1 | 22.1 | 1.2 | 0 | 0 | 8.6 |
| | 15 | 39 | 21.5 | 37.3 | 20.3 | 1.3 | 0 | 0 | 8.6 |
| | 16 | 39 | 20.6 | 38.3 | 22.6 | 1.6 | 0 | 0 | 9.8 |
| | 17 | 40 | 22.7 | 41.3 | 18.7 | 1.6 | 0. | 0 | 9.0 |
| | 18 | 39.1 | 20.6 | 30.6 | 16.9 | 2.2 | 0 | 0 | 10.6 |
| May | 19 | 39.1 | 20.6 | 47.4 | 26.9 | 1.7 | 0 | 0 | 10.4 |
| | 20 | 39.9 | 21.8 | 43.7 | 24.7 | 2.0 | 0.2 | 0 | 9.2 |
| | 21 | 39 | 24.2 | 55.6 | 33.9 | 3.0 | 1.4 | 1 | 8.3 |
| | 22 | 41.2 | 25.3 | 58.6 | 30.1 | 5.6 | 6.6 | 1 | 10.6 |
| June | 23 | 38.6 | 24.2 | 66.6 | 39.6 | 4.2 | 1.8 | 1 | 10.0 |
| | 24 | 37.9 | 23.7 | 55.9 | 41.7 | 4.6 | 36.4 | 0 | 5..5 |
| | 25 | 37.1 | 24.1 | 70.4 | 58.4 | 8.4 | 0 | 0 | 7.4 |
| | 26 | 35.5 | 24.8 | 72.7 | 62.1 | 3.5 | 108.2 | 6 | 4.2 |
| July | 27 | 32.7 | 23.7 | 79.1 | 69.6 | 4.3 | 16.8 | 2 | 3.2 |
| | 28 | 31.5 | 23.3 | 82.7 | 73.4 | 4.1 | 9.0 | 1 | 0.5 |
| | 29 | 29.6 | 23.6 | 75.9 | 66.9 | 2.5 | 22.6 | 1 | 2.0 |
| | 30 | 28.5 | 22.9 | 84.3 | 65.7 | 2.6 | 2.0 | 0 | 2.0 |
| | 31 | 29.6 | 22.8 | 82.1 | 71.9 | 1.2 | 127.8 | 3 | 2.3 |
| Aug | 32 | 28.3 | 22.2 | 69.9 | 65.4 | 2.7 | 0.6 | 0 | 1.6 |
| | 33 | 30.1 | 23.0 | 72.0 | 59.0 | 8.3 | 1.0 | 0 | 3.4 |
| | 34 | 30.6 | 22.0 | 72.1 | 55.1 | 4.7 | 0 | 0 | 5.2 |
| | 35 | 31.8 | 22.8 | 69.6 | 53.1 | 2.0 | 1.6 | 0 | 3.7 |
| Sep. | 36 | 31.7 | 22.8 | 69.6 | 53.1 | 2.0 | 1.6 | 0 | 3.7 |
| | 37 | 30.9 | 20.3 | 75.6 | 58 | 3.6 | 0.0 | 0 | 5.4 |
| | 38 | 31.4 | 21.9 | 86.3 | 77.1 | 2.2 | 62 | 3 | 2.5 |
| | 39 | 28.8 | 22.3 | 82 | 65.7 | 2.9 | 163.6 | 0 | 2.2 |
| Oct. | 40 | 29.5 | 23.4 | 79.5 | 64.3 | 2.5 | 1.1 | 0 | 2.4 |
| | 41 | 31.6 | 20.6 | 80.4 | 53.3 | 2.8 | 110 | 3 | 3.9 |
| | 42 | 31.8 | 17.2 | 66.6 | 39.0 | 0.7 | 0.0 | 0 | 7.1 |
| | 43 | 31.3 | 16.4 | 65.9 | 35.0 | 0.4 | 0.0 | 0 | 8.1 |
| Nov. | 44 | 30.1 | 13.4 | 51.4 | 40.6 | 0.4 | 0.0 | 0 | 9.5 |
| | 45 | 29.6 | 11.7 | 52.0 | 25.3 | 0.4 | 0.0 | 0 | 9.5 |

| Month | Met. Week | Temperature ($^0C$) | | Relative humidity (%) | | Wind velocity ($kmhr^{-1}$) | Rain fall (mm) | Rainy days | Sun shine hrs. |
|---|---|---|---|---|---|---|---|---|---|
| | | Max. | Min. | Morn. | Even. | | | | |
| | 46 | 29.5 | 12.6 | 64.4 | 40.7 | 0.5 | 0.0 | 0 | 7.5 |
| | 47 | 31.3 | 14.4 | 65.9 | 35.0 | 0.4 | 0.0 | 0 | 8.1 |
| Dec. | 48 | 31.7 | 15.8 | 69.6 | 53.1 | 0.5 | 0.6 | 0 | 6.7 |
| | 49 | 30.9 | 15.3 | 65.6 | 58 | 0.6 | 0.0 | 0 | 7.4 |
| | 50 | 31.4 | 13.9 | 62.3 | 77.1 | 0.7 | 0.0 | 0 | 2.5 |
| | 51 | 28.8 | 14.3 | 64 | 65.7 | 0.9 | 2.6 | 0 | 0.2 |

**Table 3.2 Treatment wise nutrient dose applied to preseasonal sugarcane**

| Tr. No. | Treatment | N | $P_2O_5$ | $K_2O$ | FYM | AgRho |
|---|---|---|---|---|---|---|
| | | (kg $ha^{-1}$) | | | (t $ha^{-1}$) | 100 ml |
| $T_1$ | GRDF | 340 | 170 | 170 | 25 | - |
| $T_2$ | 80% RDF uncoated + Ag Rho N protect-B, 0.3% | 289 | 170 | 170 | 25 | 0.3 |
| $T_3$ | 80% RDF neem coated + Ag Rho N protect-B, 0.3% | 289 | 170 | 170 | 25 | 0.3 |
| $T_4$ | 80% RDF uncoated | 289 | 170 | 170 | 25 | - |
| $T_5$ | 80% RDF uncoated + Ag Rho N protect-B, 0.2% | 289 | 170 | 170 | 25 | 0.2 |
| $T_6$ | 80% RDF neem coated + Ag Rho N protect-B, 0.2% | 289 | 170 | 170 | 25 | 0.2 |
| $T_7$ | 80% RDF neem coated | 289 | 170 | 170 | 25 | - |
| $T_8$ | Absolute control | - | - | - | - | - |

### 3.3 Layout of the Field Experiment

The details of the layout of field experiment for preseasonal sugarcane are depicted in Fig.3. 1 .

### 3.4 Experimental details and methodology

Field experiment on preseasonal sugarcane was conducted at Soil Test Crop Response Correlation Project Research Farm, Department of Soil Science and Agricultural Chemistry, M.P.K.V., Rahuri during 2015-16.

Preseasonal sugarcane (CoM -10001) was taken as a test crop. The Rho N protect levels were used as per treatments. The agronomic practices and fertilizer applications were followed as per recommended package of practices. The plant samples were collected treatment wise as per treatments at earthing up, grand growth stage and harvest. These plant samples were processed in laboratory and analyzed for their nutrient concentration and uptake. The initial representative soil sample were taken before plantation and application of fertilizer from experimental field. The soil samples were also collected at harvest of preseasonal sugarcane treatment wise. These soil samples were analyzed for soil available nitrogen, phosphorus, potassium and DTPA micronutrients.

**Table 3.3 Experimental details**

| Sr. No. | Particulars | 2015-16 |
|---|---|---|
| **I.** | **Preseasonal sugarcane** | |
| A. | Crop variety | Sugarcane (CoM-10001) |
| B. | Location | STCR Farm, M.P.K.V., Rahuri |
| C. | Experimental design | Randomized Block Design |
| D. | Number of replications | 3 |
| E. | Plot size | Gross – 6.0m x 4.0 m<br>Net – 4.5 m x 3.60 m |
| F. | Spacing | 90 cm (Ridges of furrows) |
| G. | Seed rate | 25000 sets $ha^{-1}$ |
| H. | Cultural operation | |
| 1. | Ploughing | 18.11.2015 |
| 2. | Discing | 20.11.2015 |
| 3. | Preparation of ridges and furrows | 22.11.2015 |
| 4. | Preparation of layout | 26.11.2015 |
| 5. | Application of FYM | 6.12.2015 |
| I. | Planting | 8.12.2015 |
| J. | Application of fertilizer | |
| 1. | First dose of fertilizer | 8.12.2015 |
| 2. | Second dose of fertilizer | 22.02.2016 |
| 3. | Third dose of fertilizer | 20.04.2016 |
| 4. | Fourth dose of fertilizer | 16.06.2016 |
| L. | Harvesting | 14.12.2016 |

**Treatment details**

$T_1$ : GRDF (340:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM)

$T_2$ : 80% RDF uncoated + Ag Rho N protect-B, 0.3% (289:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM)

$T_3$ : 80% RDF neem coated + Ag Rho N protect-B, 0.3% (289:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM)

$T_4$ : 80% RDF uncoated

$T_5$ : 80% RDF uncoated + Ag Rho N protect-B, 0.2% (289:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM)

$T_6$ : 80% RDF neem coated + Ag Rho N protect-B, 0.2% (289:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM)

$T_7$ : 80% RDF neem coated

$T_8$ : Absolute control

**NOTE :** RDF-Recommended dose of chemical fertilizers (340:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$)

**Table 3.4 Fertilizer application schedule for sugarcane**

| Sr. No. | Time of fertilizer application | N (%) | $P_2O_5$ (%) | $K_2O$ (%) |
|---|---|---|---|---|
| 1. | At planting | 10 | 50 | 50 |
| 2. | 6 to 8 weeks after planting | 40 | - | - |
| 3. | 12 to 16 weeks after planting | 10 | - | - |
| 4. | At earthing up | 40 | 50 | 50 |

### 3.5 Laboratory studies

#### 3.5.1 Soil analysis

The representative soil samples were collected from each plot after harvest of preseasonal sugarcane. The collected soil samples were air dried in laboratory, gently pounded, mixed and sieved through 2 mm sieve for laboratory analysis for biological and chemical properties.

#### 3.5.2 Plant analysis

The representative cane and top samples were collected from each plot after harvest of preseasonal sugarcane. The collected samples were sun dried and then oven dried at $70^0$C ± 2 $^0$C. The dried samples were ground to fine powder used for nutrient analysis.

### 3.6 Laboratory Incubation Study

The laboratory incubation study was carried out at ambient conditions. Two kilogram processed soil was saturated with deionized water in plastic bowl and allow to evaporate to moisture at field capacity moisture (42%). The slow release nitrogenous fertilizer was applied as per treatment. Then from each 2 kg treated soil 100g of soil was taken in plastic bottle for periodical analysis in an incubation by destructive method. The soil moisture was maintained at field capacity by gravimetric method. The periodical nutrient release *viz.*, N,P,K, $NH_4^+$–N, $NO^{-3}$-N and enzyme activity *viz.*, urease and dehydrogenase were assessed at an interval of 7, 14, 21, 30, 45 and 60 days by adopting standard methods (Table 7).

**Table 3.5 Chemical and biological properties of experimental soil**

| Sr. No. | Soil properties | Value |
|---|---|---|
| **A.** | **Chemical properties** | |
| 1. | pH (1: 2.5) | 7.6 |
| 2. | EC ($dSm^{-1}$) | 0.39 |
| 3. | Available N (kg $ha^{-1}$) | 204 |
| 4. | Available $P_2O_5$ (kg $ha^{-1}$) | 18 |
| 5. | Available $K_2O$ (kg $ha^{-1}$) | 320 |
| 6. | DTPA Fe (mg $kg^{-1}$) | 8.21 |
| 7. | DTPA Mn (mg $kg^{-1}$) | 14.50 |
| 8. | DTPA Zn (mg $kg^{-1}$) | 0.61 |
| 9. | DTPA Cu (mg $kg^{-1}$) | 4.43 |
| **B.** | **Biological properties** | |
| 1. | Urease enzyme (mg $NH_4$-N 100 $g^{-1}$ of soil 24 $hr^{-1}$) | 23.14 |
| 2. | DHA enzyme (ug TPF $g^{-1}$ soil 24 $hr^{-1}$) | 28.74 |
| 3. | Bacterial count (cfu x $10^6$ $g^{-1}$ soil) | 18 |

**Table 3.6 Fertilizers applied in the pot for incubation study**

| Sr. No | Treatment | Fertilizers(g $kg^{-1}$soil) | | | | |
|---|---|---|---|---|---|---|
| | | Urea | Ag Rho N Protect | SSP | MOP | FYM |
| $T_1$ | GRDF | 1.31 | - | 1.89 | 0.50 | 44.6 |
| $T_2$ | 80% RDF uncoated + Ag Rho N protect-B, 0.3% (289:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM) | 1.11 | 0.077 | 1.89 | 0.50 | 44.6 |
| $T_3$ | 80% RDF neem coated + Ag Rho N protect-B, 0.3% (289:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM) | 1.11 | 0.077 | 1.89 | 0.50 | 44.6 |
| $T_4$ | 80% RDF uncoated | 1.11 | - | 1.89 | 0.50 | 44.6 |
| $T_5$ | 80% RDF uncoated + Ag Rho N protect-B, 0.2% (289:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM) | 1.11 | 0.051 | 1.89 | 0.50 | 44.6 |
| $T_6$ | 80% RDF neem coated + Ag Rho N protect-B, 0.2% (289:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM) | 1.11 | 0.051 | 1.89 | 0.50 | 44.6 |
| $T_7$ | 80% RDF neem coated | 1.11 | - | 1.89 | 0.50 | 44.6 |
| $T_8$ | Absolute control | - | - | - | - | - |

**Table 3.7 Methods used**

| Sr. No. | Property | Method adopted | Reference |
|---|---|---|---|
| **A.** | **Soil analysis** | | |
| 1. | pH (1:2.5) | Potentiometric | Jackson (1973) |
| 2. | EC (1:2.5) | Conductometry | Jackson (1973) |
| 3. | Organic carbon (%) | Wet oxidation | Nelson and Sommer (1982) |
| 4. | $CaCO_3$ content (%) | Acid neutralization | Alison and Moodier (1965) |
| 5. | Total N (%) | Micro Kjeldahl | Bremner and Malvaly (1970) |
| 6. | Available N (kg $ha^{-1}$) | Alkaline permanganate | Subbiah and Asija (1956) |
| 7. | Available $P_2O_5$ (kg $ha^{-1}$) | 0.5 M $NaHCO_3$ at pH 8.5 Ascorbic acid | Olsen *et al*. (1954) |
| 8. | Available $K_2O$ (kg $ha^{-1}$) | N *N* $NH_4OAc$ | Chapman and Pratt(1961) |
| 9. | DTPA Fe, Mn, Cu, Zn | Atomic Absorption Spectrophotometer | Lindsay and Norvell (1978) |
| 10. | Urease | Titrimetric | Tabatabai and Bremner (1972) |
| 11. | Dehydrogenase | Spectrophotometry | Casida *et al.* (1964) |
| **B.** | **Soil micro-organism** | | |
| 1. | Bacteria | Serial dilution plating technique | Halvorsun and Zeiglar (1993) |
| **C.** | **Plant analysis** | | |
| 1 | Total nitrogen | Micro Kjeldahl | Jackson (1973) |
| 2 | Total phosphorus | Vanado molybdate phosphoric acid yellow colour method in nitric acid | Jackson (1973) |
| 3 | Total potassium | Flame photometry | Chapman and Pratt (1961) |
| **D.** | **Juice quality parameter** | | |
| 1 | Reducing sugars | Fehling solution method | Lane and Euton (1993) |
| 2 | POL | Poloriscope | Lane and Euton (1993) |
| 3 | Brix | Hand Refractometry | A.O.A.C.(2016) |

## 3.7 Statistical Analysis

The experimental data were subjected to determine the effects due to treatment and other factors. Simple correlations, linear regression equations and multiple regression equations were calculated by following the procedure given by Panse and Sukhatme (1985).

# 4. RESULTS AND DISCUSSIONS

The field experiment on effect of slow release nitrogenous fertilizer on preseasonal sugarcane was conducted at Soil Test Crop Response Correlation Scheme, Research Farm during 2015- 2016 and laboratory incubation study was conducted at Department of Soil Science and Agril. Chemistry under ambient conditions in laboratory during 2015-2016. The results obtained in field experiment and laboratory on study are discussed under appropriate heads.

## 4.1 Effect of slow release nitrogenous fertilizers on soil enzymes and nitrogen fractions

The laboratory soil incubation study with treatments of slow release nitrogenous fertilizer and N protect was conducted under ambient condition in the laboratory, Department of Soil Science and Agril. Chemistry. Two kilogram of soils was taken in plastic bowls and saturated with deionized water and then allowed to evaporate the moisture to field capacity by gravimetric method. At field capacity moisture, the soils in bowls were mixed homogenously. Then 100 g of soils from the bowl was filled in plastic bottle and treated with slow release nitrogenous fertilizer as per treatment. These plastic bottles were allowed for incubation at ambient conditions. The periodical soil analysis were carried for soil enzymes *viz.*, dehydrogenase,urease activity and nitrate, ammonical nitrogen. and available nitrogen.

### 4.1.1 Effect of slow release nitrogenous fertilizer on soil dehydrogenase enzyme activity

The soil dehydrogenase enzyme activity as influenced by graded levels of nitrogen through slow release nitrogenous fertilizer in an incubation study are reported in Table 4.1. The general recommended dose of fertilizer recorded significantly the higher value of dehydrogenase enzyme activity at all the periods of incubation and the highest at 30 DAA (46.72 µg TPF $g^{-1}$ soil 24 $hr^{-1}$). Thereafter, it was decreased at 60 DAA (43.75 µg TPF $g^{-1}$ soil 24 $hr^{-1}$). However, the decreased levels of nitrogen applied decreased the dehydrogenase activity and the least in absolute control.

The higher dehydrogenase enzyme activity might be associated with the nitrogen application through recommended dose of fertilizer.The higher dehydrogenase enzyme activity might be associated with the N protect and nitrogen are sufficient to microorganism as a source of their energy. Similarly, the addition of along with FYM general recommended dose of fertilizers provides enough carbon in soil. This carbon was used as source of energy by the organisms and influenced the population of microorganisms leads to higher dehydrogenase activity. Similar observations were also reported by Goutami *et al.* (2015) and Singaram Kamalakumari (1995).

### 4.1.2 Effect of slow release nitrogenous fertilizer on urease enzyme activity

The soil urease enzyme activity under laboratory incubation study was significantly influenced by slow release nitrogenous fertilizers (Table 4.2). The soil urease enzyme activity was significantly highest in general recommended dose of fertilizers treatment than the rest of treatments at all the periods of incubation. It was numerically the highest at 60 DAA (40.43 µg $NH_4$-N $g^{-1}$ soil $hr^{-1}$) and cumulative (207.86 µg $NH_4$-N $g^{-1}$ soil $hr^{-1}$). It was followed by 80% RDF-neem coated + Ag Rho-N protect B, 0.3% and 80% RDF neem coated + Ag Rho-N protect-B, 0.2%. However, remaining treatments were statistically on par with each other for urease enzyme activity except 80% RDF neem coated urea and absolute control. Similar observation was also reported by Salam *et al.* (1999) and Kissel *et al.* (2008). The higher soil urease enzyme activity might be associated with the nitrogen application through Ag Rho-N protect-B and neem coated urea along with Farm yard manure provides nitrogen and carbon slowly as source of nitrogen, enhanced the soil microbial population of the cells of these organisms are the major source of urease enzyme in soils.

**Table 4.1 Effect of slow release nitrogenous fertilizer on periodical soil dehydrogenase enzyme activity under laboratory incubation study**

| Sr. No. | Treatment | Dehydrogenase enzyme activity (µgTPF $g^{-1}$ soil 24 $hr^{-1}$) | | | | | | Mean (Cumulative) |
|---|---|---|---|---|---|---|---|---|
| | | 7 DAA | 14 DAA | 21 DAA | 30 DAA | 45 DAA | 60 DAA | |
| 1 | GRDF (340:170:170 kg $ha^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t $ha^{-1}$ FYM) | 42.48 | 43.19 | 44.62 | 46.72 | 46.06 | 43.75 | 44.47 (266.82) |
| 2 | 80% RDF uncoated + Ag Rho N protect-B, 0.3% (289:170:170 kg $ha^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t $ha^{-1}$ FYM) | 38.91 | 40.17 | 41.32 | 41.81 | 40.82 | 29.28 | 38.71 (232.31) |
| 3 | 80% RDF neem coated + Ag Rho N protect-B, 0.3% (289:170:170 kg $ha^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t $ha^{-1}$ FYM) | 33.82 | 34.22 | 34.87 | 35.28 | 34.91 | 36.02 | 34.85 (209.12) |
| 4 | 80% RDF uncoated | 37.08 | 37.64 | 39.29 | 39.59 | 39.23 | 37.9 | 38.45 (230.72) |
| 5 | 80% RDF uncoated + Ag Rho N protect-B, 0.2% (289:170:170 kg $ha^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t $ha^{-1}$ FYM) | 40.11 | 40.76 | 41.24 | 42.24 | 40.13 | 39.36 | 40.64 (243.86) |
| 6 | 80% RDF neem coated + Ag Rho N protect-B, 0.2% (289:170:170 kg $ha^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t $ha^{-1}$ FYM) | 28.8 | 30.21 | 30.62 | 31.91 | 33.32 | 34.34 | 31.33 (189.02) |
| 7 | 80% RDF neem coated | 29.04 | 29.91 | 30.82 | 31.40 | 31.72 | 32.66 | 30.92 (185.25) |
| 8 | Absolute control | 25.46 | 26.16 | 28.18 | 28.11 | 27.1 | 25.95 | 26.82 (160.95) |
| | Initial value | | | | 28.74 | | | |
| | S.E.m± | 0.28 | 0.31 | 0.43 | 0.24 | 0.23 | 0.47 | - |
| | CD at 5% | 0.86 | 0.94 | 1.31 | 0.73 | 0.69 | 1.43 | - |

(Figures in parentheses are Cumulative of periodical analysis)

### 4.1.3 Effect of slow release nitrogenous fertilizer on periodical soil ammonical nitrogen content

The periodical soil ammonical nitrogen content as influenced by the slow release nitrogeneous fertilizers are reported in Table 4.3. The ammonical nitrogen content in soils was significantly the highest at all the period of incubation in treatment general recommended dose of fertilizers. It was the highest at 60 DAA (44.07 µg $NH_4$-N $g^{-1}$ soil $hr^{-1}$) and closely followed by the treatment 80% RDF neem coated + Ag Rho–N protect-B, 0.3% (42.06 µg $NH_4$-N $g^{-1}$ soil $hr^{-1}$). The treatment 80% RDF uncoated, 80% RDF uncoated+ Ag Rho-N protect-B, 0.2%, 80% RDF neem coated + Ag Rho-N protect –B, 0.2% and 80% RDF neem coated were statistically on par with each other Dahiya *et al.* (2004) . In general the ammonical nitrogen content in the soil was increased with increased period of incubation in all the treatments except absolute control. It was significantly highest in general recommended dose of fertilizer treatment at all the periods of incubation followed by 80% RDF neem coated + Ag Rho-N protect-B, 0.3%.

**Table 4.2 Effect of slow release nitrogeneous fertilizer on periodical soil urease enzyme activity under laboratory condition**

| Sr. No. | Treatment | Urease enzyme activity (µg$NH_4$ –N $g^{-1}$ soil $hr^{-1}$) | | | | | | Mean (Cumulative) |
|---|---|---|---|---|---|---|---|---|
| | | 7 DAA | 14 DAA | 21 DAA | 30 DAA | 45 DAA | 60 DAA | |
| 1 | GRDF (340:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM) | 30.50 | 31.13 | 33.07 | 35.43 | 37.30 | 40.43 | 34.64 (207.84) |
| 2 | 80% RDF uncoated + Ag Rho N protect-B, 0.3% (289:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM) | 23.47 | 23.93 | 26.30 | 27.37 | 29.20 | 32.00 | 27.04 (162.24) |
| 3 | 80% RDF neem coated + Ag Rho N protect-B, 0.3% (289:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM) | 23.33 | 24.53 | 26.43 | 30.37 | 32.40 | 36.12 | 28.83 (173.36) |
| 4 | 80% RDF uncoated | 21.50 | 22.13 | 24.50 | 25.27 | 27.67 | 28.88 | 24.99 (149.95) |
| 5 | 80% RDF uncoated + Ag Rho N protect-B, 0.2% (289:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM) | 21.10 | 21.67 | 22.03 | 23.17 | 24.63 | 29.83 | 23.73 (142.43) |
| 6 | 80% RDF neem coated + Ag Rho N protect-B, 0.2% (289:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM) | 22.83 | 23.70 | 26.03 | 27.57 | 29.02 | 32.13 | 26.88 (161.28) |
| 7 | 80% RDF neem coated | 18.70 | 19.67 | 20.90 | 22.81 | 24.77 | 26.90 | 22.29 (133.75) |
| 8 | Absolute control | 17.24 | 18.21 | 19.53 | 20.93 | 21.44 | 23.11 | 20.07 (120.46) |
| | Initial value | | | | 23.14 | | | |
| | S.E.m± | 1.016 | 0.960 | 0.530 | 0.470 | 0.458 | 1.29 | - |
| | CD at 5% | 3.084 | 2.913 | 1.610 | 1.427 | 1.389 | 3.93 | - |

(Figures in parentheses are cumulative of periodical analysis)

### 4.1.4 Effect of slow release nitrogenous fertilizer on periodical soil nitrate nitrogen content

The periodical soil nitrate nitrogen content was significantly influenced by the treatment general recommended dose of fertilizer, 80% recommended dose of fertilizer with neem coated and uncoated along with Ag Rho-N protect B, 0.3% and 0.2% are presented in Table 4.4. The soil nitrate nitrogen content was increased with an advanced incubation period in all the treatments except 80% recommended dose of fertilizer-neem coated + Ag Rho N protect-B, 0.2%, 80% recommended dose of fertilizer neem coated and absolute control. The nitrate nitrogen content was found significantly the highest in treatment general recommended dose of fertilizer at 30, 45 and 60 DAA (15.48, 16.57 and 16.23 µg $g^{-1}$ soil respectively). It was numerically followed by treatment 80% recommended dose of fertilizer uncoated + Ag Rho-N protect-B, 0.2%. The highest nitrate nitrogen content was found at 21 DAA period of incubation irrespective of treatments except of general recommended dose of fertilizer and decreased thereafter, but more than at 7 and 14 DAA of incubation period. The release of nitrate nitrogen showed the similar trend to that ammonical nitrogen.

**Table 4.3 Effect of slow release nitrogeneous fertilizers on soil ammonical nitrogen content under laboratory condition**

| Sr. No. | Treatment | Ammonical nitrogen (µg $NH_4$ –N$g^{-1}$ soil) | | | | | | Mean (Cumulative) |
|---|---|---|---|---|---|---|---|---|
| | | 7 DAA | 14 DAA | 21 DAA | 30 DAA | 45 DAA | 60 DAA | |
| 1 | GRDF (340:170:170 kg $ha^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t $ha^{-1}$ FYM) | 40.19 | 41.83 | 42.78 | 42.95 | 43.36 | 44.07 | 42.53 (255.18 ) |
| 2 | 80% RDF uncoated + Ag Rho N protect-B, 0.3% (289:170:170 kg $ha^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t $ha^{-1}$ FYM) | 34.61 | 35.65 | 36.15 | 37.38 | 38.67 | 39.63 | 37.07 (222.06) |
| 3 | 80% RDF neem coated + Ag Rho N protect-B, 0.3% (289:170:170 kg $ha^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t $ha^{-1}$ FYM) | 36.41 | 37.65 | 38.59 | 39.51 | 40.57 | 42.06 | 39.13 (234.79) |
| 4 | 80% RDF uncoated | 32.59 | 33.65 | 34.56 | 36.21 | 36.94 | 37.58 | 32.25 (211.53) |
| 5 | 80% RDF uncoated + Ag Rho N protect-B, 0.2% (289:170:170 kg $ha^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t $ha^{-1}$ FYM) | 34.95 | 35.24 | 34.84 | 36.11 | 36.45 | 37.45 | 35.84 (215.04) |
| 6 | 80% RDF neem coated + Ag Rho N protect-B, 0.2% (289:170:170 kg $ha^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t $ha^{-1}$ FYM) | 31.24 | 31.84 | 32.72 | 33.93 | 34.97 | 35.99 | 33.44 (200.69) |
| 7 | 80% RDF neem coated | 35.38 | 36.09 | 36.33 | 36.95 | 35.87 | 36.57 | 36.19 (217.19) |
| 8 | Absolute control | 31.01 | 31.59 | 32.28 | 32.98 | 31.93 | 29.46 | 31.54 (189.25) |
| | S.E.m± | 0.639 | 0.652 | 0.823 | 0.736 | 0.500 | 0.482 | - |
| | CD at 5% | 1.939 | 1.979 | 2.497 | 2.233 | 1.517 | 1.462 | |

(Figures in parentheses are cumulative of periodical analysis)

**Table 4.4 Effect of slow release nitrogeneous fertilizer on periodical soil nitrate nitrogen content under laboratory condition**

| Sr. No. | Treatment | Nitrate nitrogen (µg $g^{-1}$ soil) | | | | | | Mean (Cumulative) |
|---|---|---|---|---|---|---|---|---|
| | | 7 DAA | 14 DAA | 21 DAA | 30 DAA | 45 DAA | 60 DAA | |
| 1 | GRDF (340:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM) | 13.23 | 12.92 | 16.09 | 15.48 | 16.57 | 16.23 | 15.08 (90.52 ) |
| 2 | 80% RDF uncoated + Ag Rho N protect-B, 0.3% (289:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM) | 12.22 | 15.46 | 15.42 | 13.60 | 12.79 | 12.23 | 13.62 (81.72) |
| 3 | 80% RDF neem coated + Ag Rho N protect-B, 0.3% (289:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM) | 11.57 | 13.52 | 14.64 | 11.84 | 11.62 | 11.09 | 12.38 (74.24) |
| 4 | 80% RDF uncoated | 10.61 | 11.27 | 12.70 | 11.61 | 10.44 | 11.22 | 11.30 (67.85) |
| 5 | 80% RDF uncoated + Ag Rho N protect-B, 0.2% (289:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM) | 11.52 | 13.70 | 14.15 | 13.06 | 12.53 | 13.63 | 13.09 (78.59) |
| 6 | 80% RDF neem coated + Ag Rho N protect-B, 0.2% (289:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM) | 14.67 | 14.88 | 15.43 | 15.70 | 14.77 | 11.77 | 14.53 (87.22) |
| 7 | 80% RDF neem coated | 10.22 | 12.64 | 12.49 | 12.41 | 13.17 | 11.53 | 12.07 (72.46) |
| 8 | Absolute control | 16.22 | 15.21 | 14.48 | 13.17 | 12.73 | 12.03 | 13.97 (83.43) |
| | S.E.m± | 0.614 | 0.783 | 0.443 | 0.606 | 0.730 | 0.764 | |
| | CD at 5% | 1.865 | 2.375 | 1.343 | 1.838 | 2.216 | 2.318 | |

(Figures in parentheses are cumulative of periodical analysis)

#### 4.1.5 Effect of slow release nitrogenous fertilizers on soil available nitrogen content

The soil available nitrogen content in soil under laboratory incubation was significantly influenced by slow release nitrogenous fertilizers (Table 4.5). The soil available nitrogen content was significantly the highest in treatment general recommended dose of fertilizers upto 45 DAA in an incubation study. However, it was significantly the highest in treatment 80% recommended dose of fertilizer neem coated + Ag Rho-N protect B, 0.3% at 60 DAA (71.07µg $g^{-1}$ soil). It was followed by general recommended dose of fertilizer (66.89 µg $g^{-1}$ soil). The general recommended dose of fertilizer treatment was statistically on par with 80% recommended dose of fertilizer + neem coated + Ag Rho N protect-B, 0.2% (64.60 µg $g^{-1}$ soil) and 80% recommended dose of fertilizer-uncoated +Ag Rho-N protect B-0.3% (61.47µg $g^{-1}$ soil). The cumulative soil available nitrogen content was numerically the highest in general recommended dose of fertilizer treatment (421.35 µg $g^{-1}$ soil) followed by 80% recommended dose of fertilizer uncoated+ Ag RhoN protect B-0.3% (367.71 µg $g^{-1}$ soil) and 80% recommended dose of fertilizer uncoated + Ag RhoN protect B, 0.2% (351.18 µg $g^{-1}$ soil). However, the rest of the treatments were recorded the least amount of soil available nitrogen during various period of incubations. The slow release of soil available nitrogen in neem coated and uncoated urea with Rho-N protect 0.2% and 0.3% might be because of Rho N protect and neem coated urea inhibit the hydrolysis of nitrogen by reducing the urease enzyme activity (Prakash *et al.,* 2002). Similar observations were recorded by Dahiya *et al.* (2004).

**Table 4.5 Effect of slow release nitrogeneous fertilizer on soil available nitrogen content under laboratory condition**

| Sr. No. | Treatment | Soil available nitrogen (µg $g^{-1}$soil) | | | | | | Mean (Cumulative) |
|---|---|---|---|---|---|---|---|---|
| | | 7 DAA | 14 DAA | 21 DAA | 30 DAA | 45 DAA | 60 DAA | |
| 1 | GRDF (340:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM) | 65.85 | 71.07 | 73.16 | 72.12 | 75.26 | 66.89 | 70.22 (421.35) |
| 2 | 80% RDF uncoated + Ag Rho N protect-B, 0.3% (289:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM) | 49.12 | 59.58 | 64.8 | 68.98 | 63.76 | 61.47 | 61.28 (367.71) |
| 3 | 80% RDF neem coated + Ag Rho N protect-B, 0.3% (289:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM) | 39.71 | 42.85 | 45.99 | 50.17 | 67.94 | 71.07 | 52.95 (317.73) |
| 4 | 80% RDF uncoated | 48.08 | 51.21 | 54.29 | 55.39 | 52.26 | 48.08 | 51.55 (309.31) |
| 5 | 80% RDF uncoated + Ag Rho N protect-B, 0.2% (289:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM) | 51.21 | 56.44 | 61.67 | 62.71 | 65.85 | 53.30 | 58.53 (351.18) |
| 6 | 80% RDF neem coated + Ag Rho N protect-B, 0.2% (289:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM) | 35.53 | 41.8 | 42.85 | 44.95 | 49.12 | 64.60 | 46.47 (278.85) |
| 7 | 80% RDF neem coated | 31.44 | 38.67 | 41.80 | 42.85 | 52.26 | 54.35 | 43.56 (261.37) |
| 8 | Absolute control | 39.71 | 38.67 | 38.68 | 31.99 | 32.40 | 27.17 | 34.77 (208.62) |
| | Initial | | | | 48.72 | | | - |
| | S.E.m± | 1.24 | 1.48 | 1.61 | 1.54 | 1.66 | 1.51 | - |
| | CD at 5% | 3.79 | 4.50 | 4.89 | 4.67 | 5.06 | 4.59 | - |

(Figures in parentheses are cumulative of periodical analysis)

### 4.2 Field Experiment

The field experiment was conducted during 2015-2016 at Soil Test Crop Response Correlation Scheme, Research Farm. The treatment consisted of general recommended dose of fertilizer (340:170:170 kg $ha^{-1}$ N, $P_2O_5$ and $K_2O$ + 20 t $ha^{-1}$ FYM ), RDF uncoated + Ag Rho 0.3%, neem coated RDF + Ag Rho 0.3%, RDF uncoated , RDF uncoated + Ag Rho 0.2%, RDF neem coated + Ag Rho 0.2%, RDF neem coated and absolute control. The results obtained are discussed here.

### 4.2.1 Effect of slow release nitrogenous fertilizers on yield contributing characters of preseasonal sugarcane

The nitrogen application to sugarcane crop influenced the vegetative growth, cane height, girth, number of leaves and internodes. However, the slow release nitrogenous fertilizers are more beneficial to the various growth characters of sugarcane crop irrespective of growing season. The slow release nitrogenous fertilizer provides the nitrogen continuously and coincides with the physiological growth stages of sugarcane. which are reflecting on growth characteristics and higher cane and commercial cane sugar yield. In the present investigation the yield contributing characters of preseasonal sugarcane *viz.*, cane girth, number of internodes, number of leaves, millable cane height and total cane height as influenced by slow release nitrogenous fertilizer neem coated urea and Ag Rho-N protect-B are presented in Table 4.6. Similar observations were reported by Londhe (1982) and Kadam (1986).

### 4.2.2 Cane girth

The cane girth of preseasonal sugarcane was significantly influenced by the slow release nitrogenous fertilizers. It was significantly higher in general recommended dose of fertilizer (14.25 cm). However, the treatment 80% recommended dose of fertilizer neem coated + Ag Rho-N protect B, 0.3%, 80% recommended dose of fertilizer neem coated + Ag Rho-N protect B, 0.2% and 80% recommended dose of fertilizer neem coated were found statistically on par with each other for cane girth (13.41, 13.20 and 12.91 cm respectively). This might be associated with the neem coated urea alone or in combination with Ag Rho either 0.3% or 0.2% was released the nitrogen slowly and provides to the sugarcane for a longer period , which were reflected in higher cane girth.

The millable cane height and total cane height was significantly higher in treatment 80% recommended dose of fertilizer neem coated + Ag Rho N protect B, 0.3% (273.16 and 364.50 cm). Whereas, 80% recommended dose of fertilizer neem coated + Ag Rho-N protect-B 0.3%. However, 80% recommended dose of fertilizer neem coated + Ag Rho-N protect-B 0.3%, 80% recommended dose of fertilizer neem coated + Ag Rho-N protect B-0.2% and absolute control were statistically on par for millable cane height (266.60, 267.56, 261.56 and 255.45 cm respectively). The treatment 80% recommended dose of fertilizer uncoated, 80% recommended dose of fertilizer uncoated + Ag Rho N protect-B 0.2%, 80% recommended dose of fertilizer neem coated + Ag Rho-N protect B 0.2%, and absolute control were statistically on par for total cane height (304.20, 295.83, 324.50 and 296.30 cm respectively). Similar observations were also recorded reported by Londhe(1982) and Kadam (1986).

**Table 4.6 Effect of slow release of nitrogenous fertilizer on yield contributing characters of preseasonal sugarcane**

| Sr. No. | Treatment | Cane girth (cm) | Number of internode | No. of leaves | Milliable cane height (cm) | Total cane height (cm) |
|---|---|---|---|---|---|---|
| 1 | GRDF (340:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM) | 14.25 | 33.00 | 13.8 | 230.0 | 265.50 |
| 2 | 80% RDF uncoated + Ag Rho N protect-B, 0.3% (289:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM) | 12.40 | 28.00 | 12.25 | 266.60 | 332.87 |
| 3 | 80% RDF neem coated + Ag Rho N protect-B, 0.3% (289:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM) | 13.41 | 31.25 | 14.5 | 273.16 | 364.50 |
| 4 | 80% RDF uncoated | 12.18 | 27.00 | 13.2 | 248.66 | 304.20 |
| 5 | 80% RDF uncoated + Ag Rho N protect-B, 0.2% (289:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM) | 12.31 | 25.50 | 12.11 | 251.16 | 295.83 |
| 6 | 80% RDF neem coated + Ag Rho N protect-B, 0.2% (289:170:170 kg $ha^{-1}$ $N:P_2O_5:K_2O$ + 25 t $ha^{-1}$ FYM) | 13.20 | 27.00 | 13.88 | 261.56 | 324.50 |
| 7 | 80% RDF neem coated | 12.91 | 28.00 | 12.8 | 267.34 | 264.43 |
| 8 | Absolute control | 11.05 | 22.00 | 11.75 | 255.45 | 296.30 |
| | S.E.m± | 0.35 | 0.70 | 0.637 | 5.88 | 16.44 |
| | CD at 5% | 0.758 | 2.134 | 1.61 | 17.85 | 49.87 |

Thus, the application of 80% RDF coated along with Ag Rho-N protect–B 0.2% or 0.3% are beneficial for enhancing sugarcane plant height. The slow release of nitrogen through coated urea and uncoated urea with Ag Rho-N protect–B was continuously provided the nitrogen during active growth period of sugarcane. This might enhanced the growth and development of sugarcane.

### 4.3 Effect of slow release nitrogenous fertilizers on cane, commercial cane sugar yield and nutrient uptake

The cane and commercial cane sugar yield of preseasonal sugarcane are the function of nutrient management. The supplementation of nutrients slowly during their crucial growth phase resulted in yield and yield contributing characteristics of a particular crop. Similarly, it has also impact on nutrient absorption by crop. The nutrient uptake also contribute to increase in yield of crops. The results obtained in respect to cane yield, commercial cane yield and nutrient uptake by the application of neem coated and Ag Rho-N protect B fertilizers are discussed here.

#### 4.3.1 Cane and commercial cane sugar (CCS) yield

The cane and commercial cane sugar (CCS) yield as influenced by the slow release nitrogenous fertilizers are reported in Table 4.7. The cane yield of preseasonal sugarcane was significantly higher in general recommended dose of fertilizer (242.4 MT $ha^{-1}$) over rest of the treatments. However, it was numerically followed by treatment 80% RDF neem coated + Ag Rho-N protect B 0.2% (212.81 MT $ha^{-1}$). However, this treatment was statistically on par with 80% RDF uncoated + Ag Rho-N protect-B 0.3% (208.7 MT $ha^{-1}$) and 80% RDF neem coated (208.41 MT $ha^{-1}$).

**Table 4.7 Effect of slow release nitrogenous fertilizer on cane, commercial cane sugar yield and nutrient uptake**

| Sr. No. | Treatment | Yield (MT $ha^{-1}$) | | Total nutrient uptake (kg $ha^{-1}$) | | |
|---|---|---|---|---|---|---|
| | | Cane | CCS | N | P | K |
| 1 | GRDF (340:170:170 kg $ha^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t $ha^{-1}$ FYM) | 242.40 | 25.49 | 162.70 | 45.39 | 98.14 |
| 2 | 80% RDF uncoated + Ag Rho N protect-B, 0.3% (289:170:170 kg $ha^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t $ha^{-1}$ FYM) | 208.70 | 20.83 | 138.40 | 41.84 | 82.43 |
| 3 | 80% RDF neem coated + Ag Rho N protect-B, 0.3% (289:170:170 kg $ha^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t $ha^{-1}$ FYM) | 221.81 | 23.84 | 120.18 | 34.43 | 72.51 |
| 4 | 80% RDF uncoated | 201.78 | 21.08 | 138.27 | 37.44 | 88.71 |
| 5 | 80% RDF uncoated + Ag Rho N protect-B, 0.2% (289:170:170 kg $ha^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t $ha^{-1}$ FYM) | 205.40 | 25.43 | 131.80 | 32.54 | 81.85 |
| 6 | 80% RDF neem coated + Ag Rho N protect-B, 0.2% (289:170:170 kg $ha^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t $ha^{-1}$ FYM) | 212.81 | 21.34 | 116.18 | 26.31 | 75.34 |
| 7 | 80% RDF neem coated | 208.41 | 24.23 | 110.45 | 32.48 | 71.51 |
| 8 | Absolute control | 158.44 | 14.65 | 114.38 | 25.95 | 39.36 |
| | S.E.m± | 1.924 | 0.514 | 2.06 | 0.541 | 1.271 |
| | CD at 5% | 5.784 | 1.55 | 6.214 | 1.849 | 2.843 |

The commercial cane sugar yield was significantly higher in 80% RDF uncoated + Ag Rho-N protect-B 0.2% (25.43 MT $ha^{-1}$) and statistically on par with GRDF (25.49 MT $ha^{-1}$) and 80% RDF neem coated (24.23 MT $ha^{-1}$). These results revealed that the nutrient management to preseasonal sugarcane as 80% RDF neem coated with Ag Rho-N protect-B 0.3% or 80% RDF neem coated alone are more useful for higher cane and commercial cane sugar yield.

These results are in accordance with the results of (Kadam *et al.* (1991), Nasir Ahmed *et al.* (1992), Bangar and Sharma (1997), Zaman *et al.* (2009).

**4.3.2 Nutrient uptake**

The total uptake of nitrogen, phosphorus and potassium were significantly influenced by the slow release nitrogenous fertilizer application to the preaseasonal sugarcane (Table 4.7). The total uptake of nitrogen, phosphorus and potassium were significantly higher in treatment general recommended dose of fertilizer (162.70, 45.39 and 98.14 kg $ha^{-1}$ NPK respectively). It was numerically followed by treatment 80% RDF uncoated + Ag Rho-N protect-B 0.3% for nitrogen and phosphorus (138.40 and 41.84 kg $ha^{-1}$) and statistically superior over rest of the treatments. Similarly, the potassium uptake was numerically higher in treatment 80% RDF uncoated (88.71 kg $ha^{-1}$) and statistically significant over rest of the treatments.

In general, general recommended dose of fertilizer to preaseasonal sugarcane was found superior for cane, commercial cane sugar yield and total nutrient uptake. Whereas, 80% RDF neem coated with Ag Rho-N protect B 0.3% for cane yield and Ag Rho-N protect B 0.2% were recorded higher commercial cane sugar yield.

### 4.3.3 Effect of slow release nitrogenous fertilizer on juice quality at harvest of sugarcane

The use of slow release nitrogenous fertilizer to preseasonal sugarcane significantly influenced the sucrose and commercial cane sugar per cent (Table 4.8). The per cent sucrose and commercial cane sugar content was significantly higher in treatment 80% RDF uncoated + Ag Rho N protect-B 0.2% (20.57 and 14.67 per cent) and statistically on par with all the treatments except 80% RDF neem coated. The brix and purity per cent of preseasonal sugar cane juice was found higher in similar treatment but were statistically non significant.

In general, slow release nitrogen fertilizers to preseasonal sugarcane did not influence the quality of juice in respect to brix, sucrose and purity per cent.

**Table 4.8 Effect of slow release nitrogenous fertilizer on juice quality at harvest of preseasonal sugarcane**

| Sr. No | Treatment | Brix (c) | Sucrose (%) | Purity (%) | CCS (%) |
|---|---|---|---|---|---|
| 1 | GRDF (340:170:170 kg ha$^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t ha$^{-1}$ FYM) | 20.77 | 19.66 | 94.68 | 14.03 |
| 2 | 80% RDF uncoated + Ag Rho N protect-B, 0.3% (289:170:170 kg ha$^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t ha$^{-1}$ FYM) | 21.27 | 20.48 | 94.83 | 14.63 |
| 3 | 80% RDF neem coated + Ag Rho N protect-B, 0.3% (289:170:170 kg ha$^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t ha$^{-1}$ FYM) | 21.44 | 20.47 | 94.75 | 14.61 |
| 4 | 80% RDF uncoated | 21.27 | 20.13 | 93.95 | 14.32 |
| 5 | 80% RDF uncoated + Ag Rho N protect-B, 0.2% (289:170:170 kg ha$^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t ha$^{-1}$ FYM) | 21.77 | 20.57 | 94.52 | 14.67 |
| 6 | 80% RDF neem coated + Ag Rho N protect-B, 0.2% (289:170:170 kg ha$^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t ha$^{-1}$ FYM) | 21.10 | 20.20 | 95.00 | 14.44 |
| 7 | 80% RDF neem coated | 21.10 | 18.96 | 93.56 | 13.46 |
| 8 | Absolute control | 21.27 | 20.50 | 94.43 | 8.42 |
| | S.E.m± | 0.33 | 0.20 | 0.80 | 0.142 |
| | CD at 5% | N.S. | 0.60 | N.S. | 0.42 |

## 4.4 Effect of slow release nitrogenous fertilizers on residual soil properties

The residual effect of general recommended dose of fertilizers neem coated, uncoated and Ag Rho-N protect-B 0.2% and 0.3% as slow release nitrogenous fertilizers on soil properties at harvest of preseasonal sugarcane are discussed here.

### 4.4.1 Soil pH and electrical conductivity

The residual effect of slow release nitrogenous fertilizers on soil pH and electrical conductivity at harvest of preseasonal sugarcane are reported in Table 4.9. The residual effect of slow release nitrogenous fertilizer was significantly influenced the soil pH and electrical conductivity. The soil pH was numerically decreased in treatment absolute control (7.43) than the initial soil pH (7.60). and it was significantly less than the soil pH observed in rest the treatments. It was significantly higher in treatment 80% RDF uncoated (8.10) and statistically on par with GRDF, 80% RDF uncoated + Ag Rho-N protect B 0.3%, 80% RDF coated + Ag Rho-N protect-B 0.3%, and similar treatment with + Ag Rho-N protect-B 0.2% (7.98, 7.99, 7.86, 8.20 and 8.03 respectively). These results are in close conformity with the observations of Dixit and Gupta (2000) and Eghball (2002).

### 4.4.2 Soil available nitrogen, phosphorus and potassium

The residual soil available nitrogen, phosphorus and potassium as influenced by slow release nitrogenous fertilizers are reported in Table 4.9. The slow release nitrogenous fertilizers to preseasonal sugarcane significantly influenced the residual soil available nitrogen, phosphorus and potassium. The residual soil available nitrogen and phosphorus was found to be significantly higher in treatment general recommended dose of fertilizer (180.80 and 18.09 kg ha$^{-1}$), 80% RDF neem coated + Ag Rho-N protect-B 0.3% (172.70 and 17.68 kg ha$^{-1}$). However, it was on par with the 80% RDF neem coated + Ag Rho-N protect B 0.2% in respect soil available nitrogen (163.45 kg ha$^{-1}$). This might be because of neem coated fertilizer slowly release the nitrogen which was taken by the sugarcane as per requirement and left over remain in soil. The coating of fertilizer with neem did not allow the nutrients loss either through leaching or volatilization. These are reflected in higher content of residual soil available nitrogen. The rest of the treatments were recorded lower values of soil available nitrogen at harvest of preseasonal sugarcane.

**Table 4.9 Effect of slow release nitrogeneous fertilizer on residual soil pH, EC, available nitrogen, phosphorus and potassium at harvest**

| Sr. No. | Treatment | pH (1:2.5) | EC (dSm$^{-1}$) | Soil available nutrient (kg ha$^{1}$) | | |
|---|---|---|---|---|---|---|
| | | | | N | P | K |
| 1 | GRDF (340:170:170 kg ha$^{-1}$ $N:P_2O_5:K_2O$ + 25 t ha$^{-1}$ FYM) | 7.98 | 0.30 | 180.80 | 18.09 | 545.45 |
| 2 | 80% RDF uncoated + Ag Rho N protect-B, 0.3% (289:170:170 kg ha$^{-1}$ $N:P_2O_5:K_2O$ + 25 t ha$^{-1}$ FYM) | 7.99 | 0.24 | 145.12 | 14.55 | 465.40 |
| 3 | 80% RDF neem coated + Ag Rho N protect-B, 0.3% (289:170:170 kg ha$^{-1}$ $N:P_2O_5:K_2O$ + 25 t ha$^{-1}$ FYM) | 7.86 | 0.24 | 172.70 | 17.68 | 520.70 |
| 4 | 80% RDF uncoated | 8.10 | 0.23 | 131.28 | 15.88 | 448.39 |
| 5 | 80% RDF uncoated + Ag Rho N protect-B, 0.2% (289:170:170 kg ha$^{-1}$ $N:P_2O_5:K_2O$ + 25 t ha$^{-1}$ FYM) | 8.2 | 0.25 | 138.60 | 14.77 | 453.40 |
| 6 | 80% RDF neem coated + Ag Rho N protect-B, 0.2% (289:170:170 kg ha$^{-1}$ $N:P_2O_5:K_2O$ + 25 t ha$^{-1}$ FYM) | 8.03 | 0.31 | 163.45 | 15.77 | 492.30 |
| 7 | 80% RDF neem coated | 7.63 | 0.33 | 159.25 | 14.10 | 470.90 |
| 8 | Absolute control | 7.43 | 0.28 | 125.38 | 12.89 | 430.20 |
| | S.E.m± | 0.096 | 0.010 | 3.137 | 0.292 | 9.6351 |
| | CD at 5% | 0.291 | 0.032 | 9.515 | 0.885 | 29.225 |

The residual soil availale phosphorus was significantly influenced by the slow release nitrogenous fertilizers. It was significantly higher in GRDF (18.0 kg $ha^{-1}$) over rest of the treatments except 80% RDF neem coated + Ag Rho N protect-B 0.3% (17.68)

The residual soil available potassium content was found significantly higher in treatment general recommended dose of fertilizer (545.45 kg $ha^{-1}$) and statistically on par with treatment 80% RDF uncoated + Ag Rho-N protect B 0.3% (520.70kg$ha^{-1}$), 80% RDF neem coated + Ag Rho N protect B 0.2% (492.30 kg $ha^{-1}$) and 80% RDF uncoated (453.40 kg $ha^{-1}$). Thus, addition of fertilizer to preseasonal sugarcane with 80% RDF neem coated + Ag Rho-N protect B 0.3% was beneficial for residual soil available nitrogen and phosphorus at harvest. The soil available potassium at harvest of sugarcane was improved in 80% RDF uncoated + Ag Rho-N protect B 0.3% and 80% RDF uncoated.

### 4.4.3 Soil available micronutrients

The effect of slow release nitrogenous fertilizers on soil available micronutrients are reported in Table 4.10. The soil available micronutrients at harvest of preseasonal sugarcane was significantly influenced by slow release nitrogenous fertilizers. However, the soil available micronutrients were slightly increased over their initial content in soil except soil available zinc. The values of soil available micronutrients were statistically on par with each other in all treatments. However, numerically the values of soil available micronutrients did not showe considerable difference among the treatments. Similar results were also reported by Bellaki and Badanur (1997) and Mukhopadhay and Das (2001). Thus, addition of slow release nitrogenous fertilizers to preseasonal sugarcane did not vary the residual soil available micronutrients.

**Table 4.10 Effect of slow release nitrogenous fertilizer on residual DTPA micronutrient at harvest**

| Sr. No. | treatment | Soil available micronutrient (µg $g^{-1}$) | | | |
|---|---|---|---|---|---|
| | | Fe | Zn | Mn | Cu |
| 1 | GRDF (340:170:170 kg $ha^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t $ha^{-1}$ FYM) | 3.80 | 0.43 | 14.98 | 3.30 |
| 2 | 80% RDF uncoated + Ag Rho N protect-B, 0.3% (289:170:170 kg $ha^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t $ha^{-1}$ FYM) | 4.20 | 0.39 | 16.68 | 2.45 |
| 3 | 80% RDF neem coated + Ag Rho N protect-B, 0.3% (289:170:170 kg $ha^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t $ha^{-1}$ FYM) | 4.27 | 0.45 | 16.28 | 2.24 |
| 4 | 80% RDF uncoated | 4.18 | 0.44 | 15.26 | 2.83 |
| 5 | 80% RDF uncoated + Ag Rho N protect-B, 0.2% (289:170:170 kg $ha^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t $ha^{-1}$ FYM) | 4.33 | 0.43 | 14.06 | 2.51 |
| 6 | 80% RDF neem coated + Ag Rho N protect-B, 0.2% (289:170:170 kg $ha^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t $ha^{-1}$ FYM) | 4.33 | 0.41 | 16.22 | 1.83 |
| 7 | 80% RDF neem coated | 4.23 | 0.41 | 16.60 | 1.96 |
| 8 | Absolute control | 3.98 | 0.44 | 13.57 | 2.44 |
| | Initial | 4.00 | 0.51 | 14.50 | 2.43 |
| | S.E.m± | 0.052 | 0.006 | 0.38 | 0.044 |
| | CD at 5% | 0.159 | 0.020 | 1.17 | 0.134 |

## 4.5 Effect of slow release nitrogenous fertilizers on soil enzymes activity and bacterial count

The soil urease and dehydrogenase enzyme activity was significantly influenced by the residual effect of slow release nitrogenous fertilizers at harvest of preseasonal sugarcane (Table 4.11). The urease enzyme activity was found significantly superior in treatment general recommended dose of fertilizers (25.00µg $NH_4$-N $g^{-1}$ soil $hr^{-1}$) and statistically on par with the treatment 80% RDF neem coated + Ag Rho-N protect-B 0.3% (23.33 µg $NH_4$-N $g^{-1}$ soil $hr^{-1}$), 80% RDF uncoated + Ag Rho-N protect-B 0.2% (22.33 µg $NH_4$-N $g^{-1}$ soil $hr^{-1}$) and 80% RDF neem coated + Ag Rho-N protect-B 0.2% (23.67 µg $NH_4$-N $g^{-1}$ soil $hr^{-1}$) respectively. This might be because of the residual effect of higher dose of recommended dose of fertilizer and 80% of RDF with Ag-Rho-N are slowly released nitrogen in the soil as results it act as a substrate for urease enzyme activity. Simultaneously, the slow release nitrogenous fertilizers enhanced the microbial population in the soil which act might have as a source of enzyme in the soil. Similar results were also reported by Xiaoguang *et al.* (2004) and Goutami *et al.* (2015).

**Table 4.11 Effect of slow release nitrogeneous fertilizers on residual soil enzyme activity in sugarcane at harvest**

| Sr. No. | Treatment | Urease enzyme activity (µg $NH_4$ N $g^{-1}$ soil $hr^{-1}$) | Dehydrogenase enzyme activity (µg TPF $g^{-1}$ soil $hr^{-1}$) | Bacterial count (cfu×$10^6$ g soil) |
|---|---|---|---|---|
| 1 | GRDF (340:170:170 kg ha$^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t ha$^{-1}$ FYM) | 25.00 | 43.33 | 24.00 |
| 2 | 80% RDF uncoated + Ag Rho N protect-B, 0.3% (289:170:170 kg ha$^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t ha$^{-1}$ FYM) | 21.33 | 33.73 | 20.33 |
| 3 | 80% RDF neem coated + Ag Rho N protect-B, 0.3% (289:170:170 kg ha$^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t ha$^{-1}$ FYM) | 23.33 | 38.37 | 23.00 |
| 4 | 80% RDF uncoated | 19.33 | 32.47 | 18.65 |
| 5 | 80% RDF uncoated + Ag Rho N protect-B, 0.2% (289:170:170 kg ha$^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t ha$^{-1}$ FYM) | 22.33 | 31.77 | 20.32 |
| 6 | 80% RDF neem coated + Ag Rho N protect-B, 0.2% (289:170:170 kg ha$^{-1}$ N:$P_2O_5$:$K_2O$ + 25 t ha$^{-1}$ FYM) | 23.67 | 35.60 | 21.06 |
| 7 | 80% RDF neem coated | 22.67 | 34.17 | 18.12 |
| 8 | Absolute control | 19.00 | 23.40 | 15.00 |
| | Initial | 23.14 | 28.74 | 18 |
| | S.E.m± | 0.585 | 0.746 | 0.585 |
| | CD at 5% | 1.777 | 2.264 | 1.777 |

The soil dehydrogenase enzyme activity was significantly higher in general recommended dose of fertilizers (43.33 µg TPF $g^{-1}$ soil $hr^{-1}$) over rest of the treatments. However, it was numerically followed by treatment 80% RDF neem coated + Ag Rho-N protect-B 0.3% (38.37 µg TPF $g^{-1}$soil $hr^{-1}$).

The bacterial count ws found significantly it is not in $T_1$ highest in treatment 80% RDF neem coated + Ag Rho protect-B 0.3% (23.0 cfu x $10^6$ $g^{-1}$ of soil) over all the treatments.

# 5. SUMMARY AND CONCLUSIONS

The laboratory incubation and field experiment entitled "Effect of slow release nitrogenous fertilizer on yield, nutrient uptake and quality of preseasonal sugarcane in inceptisols" was conducted during 2015-2016. The laboratory incubation study was conducted at Department of Soil Science and Agricultural Chemistry and field experiment at Soil Test Crop Response Correlation Scheme, Research Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri.The results obtained are summarized and conclusions drawn are presented in this chapter.

## 5.1 Laboratory incubation study

The laboratory incubation study was conducted under ambient conditions to asses ‘‘Effect of slow release nitrogenous fertilizers on periodical soil enzyme activity and nutrient availability".

1. The general recommended dose of fertilizer recorded significantly higher activity of soil dehydrogenase enzyme up to 30 DAA followed by 80% RDF uncoated + Ag Rho N protect-B, 0.3%, 80% RDF uncoated + Ag Rho N protect-B, 0.2% treatment. The urease enzyme activity was found significantly superior in general recommended dose of fertilizer at 7, 14, 21, 30, DAA and the highest at 60 DAA.
2. The ammonical nitrogen content was increased with an increased incubation period. It was significantly higher at 60 DAA in general recommended dose of fertilizer followed by 80% RDF neem coated + Ag Rho N protect-B, 0.3%. The nitrate nitrogen content was increased at 45 DAA. It was significantly more in general recommended dose of fertilizer and increased with an advanced incubation period in all treatments except 80% RDF neem coated +Ag Rho N protect-B, 0.2% and absolute control.
3. The periodical soil available nitrogen was increased with an advanced incubation period up 45 DAA and decreased at 60 DAA.

The treatment, 80% RDF uncoated + Ag Rho N protect-B, 0.3% recorded significantly higher soil available nitrogen at 60 DAA and it was statistically on par with GRDF. However, at rest of the incubation period GRDF treatment recorded higher values of soil available nitrogen.

## 5.2 Field Study

1. The girth of internode and number of internode was higher in general recommended dose of fertilizer and number of leaves, millable cane height, and total cane height were higher in 80% RDF neem coated + Ag Rho N protect-B, 0.3% .
2. The cane and commercial cane sugar yield of preseasonal sugarcane was significantly higher in general recommended dose of fertilizer and statistically on par with 80% RDF uncoated + Ag Rho N protect-B, 0.2%. The similar trend was observed for total uptake of nitrogen, phosphorus and potassium.

3. The soil pH was numerically decreased in absolute control treatment than the treatment of slow release nitrogenous fertilizers + Ag Rho N protect-B 0.3%. It was significantly higher in treatment 80% RDF uncoated and statistically on par with GRDF.
4. The soil available nitrogen, phosphorus and potassium was significantly higher in general recommended dose of fertilizer followed by neem coated RDF 80% + Ag Rho-N protect-B, 0.3%.
5. The soil available micronutrients *viz.,* Fe, Mn, Cu and Zn were with each other in all the treatments at harvest of preseasonal sugarcane.
6. Soil urease, dehydrogenase enzyme activity and bacterial counts at harvest were significantly higher in general recommended dose of fertilizer and statistically par on with 80% RDF + Ag Rho-N protect-B 0.3%.
7. The addition of nitrogen to preseasonal sugarcane either through general recommended dose of fertilizer or neem coated with Ag Rho N protect-B 0.3% are beneficial for higher cane, commercial cane sugar yield, nutrient uptake and maintaining residual soil fertility.

## 5.3 Conclusions

The nitrogen management to preseasonal sugarcane as general recommended dose of fertilizer (340:170;170 kg $ha^{-1}$ ) N, $P_2O_5$ and $K_2O$ along with 25t $ha^{-1}$ FYM or 289 kg $ha^{-1}$ nitrogen with recommended dose of $P_2O_5$, $K_2O$ and FYM are beneficial for soil available nitrogen, ammonical nitrogen fractions and soil urease enzyme in incubation study.

The nitrogen application to preseasonal sugarcane in field experiment as per general recommended dose of fertilizer of 80% neem coated with Ag Rho-N protect-B, 0.3% are beneficial to harvest. The higher cane and commercial cane sugar yield, nutrient uptake and maintaining residual soil fertility.

The results of laboratory incubation study and field experiment are of one year experimentation needs confirmation by conducting more experimental trials.

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***** Originals are not seen

# 7. VITAE

**MR. ZODGE RANUJI BABASAHEB**

**MASTER OF SCIENCE (AGRICULTURE)**

**IN**

## SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

**2018**

| | | | |
|---|---|---|---|
| Title of thesis | | : | Effect of slow release nitrogenous fertilizer on yield, nutrient uptake and quality of preseasonal sugarcane |
| Major field | | : | Soil Science and Agricultural Chemistry |
| Biographical information | | | |
| Personal | Date of Birth | : | 25th May 1992 |
| | Place of Birth | : | Pusara, Tal. Wadvani, Dist. Beed |
| | Father's Name | : | Shri. Babasaheb Asruba Zodge |
| | Mother's Name | : | Sau. Laxmibai Babasaheb Zodge |
| Educational | Bachelor Degree Obtained | : | Netaji Subhashchandra Bose College of Agriculture, Markhel Tq. Degloor Dist. Nanded |
| | Class | : | Second |
| | Name of University | : | Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani |
| Address | | | |
| | Email-Id | : | ranujizodge111@gmail.com |
| | Contact Number | : | 9764610562 |

**Plate 4.1 $T_1$: GRDF (340:170:170 kg $ha^{-1}$ N: $P_2O_5$: $K_2O$+25t $ha^{-1}$ FYM**

**Plate 4.2 $T_2$ :80% RDF uncoated + Ag Rho N protect,0.3 %,**

**Plate 4.3 $T_3$ :80% RDF neem coated + Ag Rho N protect-B, 0.3**

**Plate 4.4 $T_4$ : 80% RDF uncoated**

**Plate 4.5 $T_5$ : 80% RDF uncoated + Ag Rho N protect-B ,0.2%**

**Plate 4.6 $T_6$ : 80% RDF neem coated + Ag Rho N protect-B, 0.2%**

**Plate 4.7 $T_7$ : 80% RDF neem coated**

**Plate 4.8 $T_8$: Absolute control**

**Note: 1. GRDF - general recommended dose of fertilizer(340:170:170 kg ha$^{-1}$ N: $P_2O_5$: $K_2O$+25t ha$^{-1}$ FYM)**

**2 . 80 % RDF -recommended dose of fertilizer (289:170:170 kg ha$^{-1}$ N: $P_2O_5$: $K_2O$+25t ha$^{-1}$ FYM)**

**Plate . 3.1. General view of experiment**

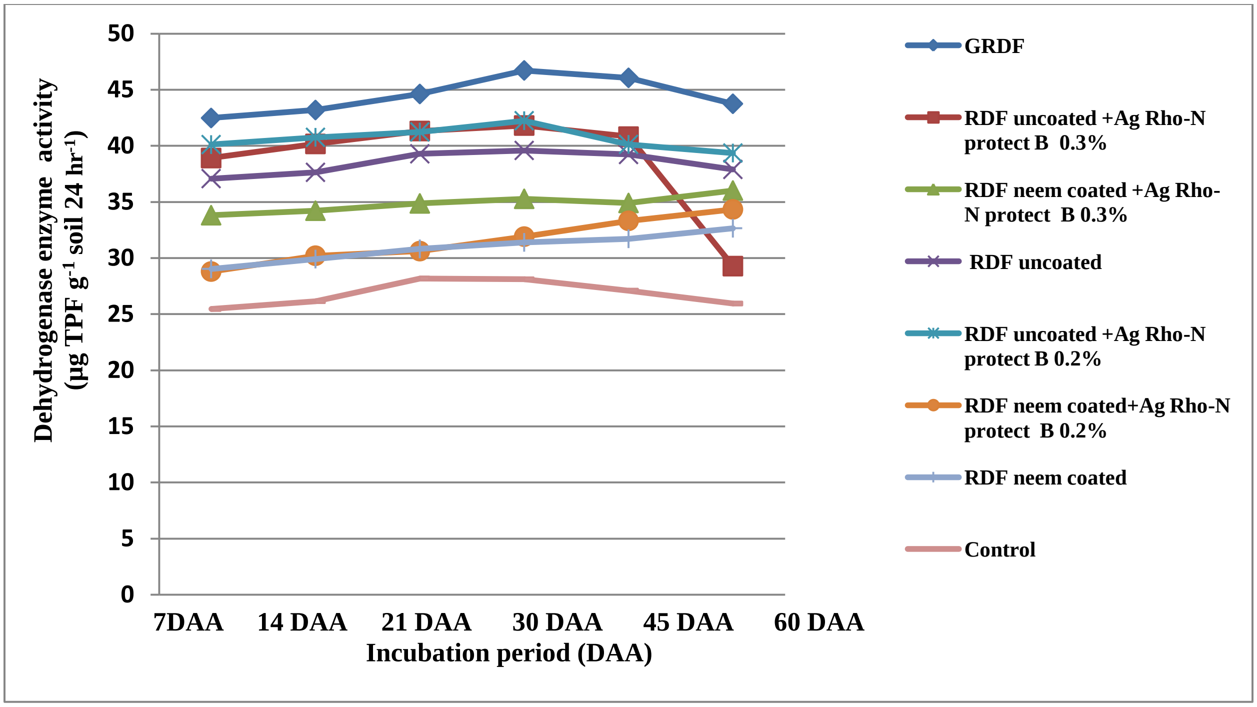


**Fig. 4.1 Effect of slow release nitrogenous fertilizer on Dehydrogenase enzyme activity under incubation study**

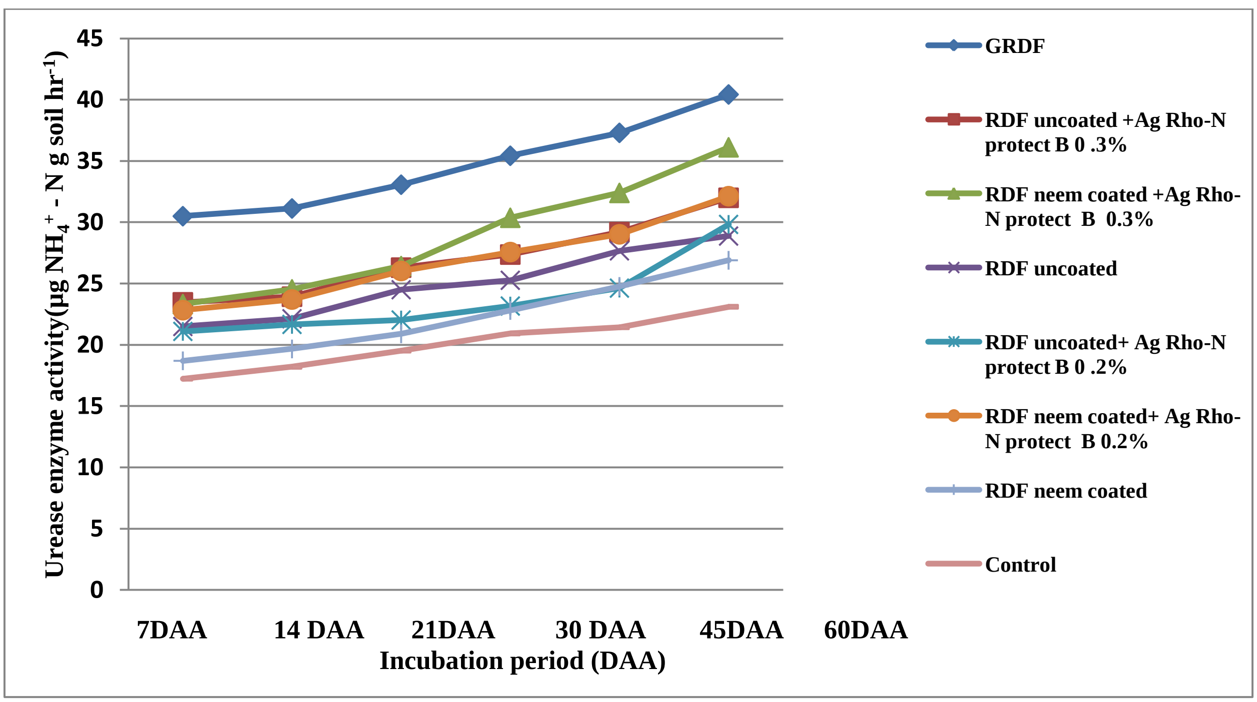


**Fig. 4.2 Effect of slow release nitrogenous fertilizer on urease enzyme activity under incubation study**

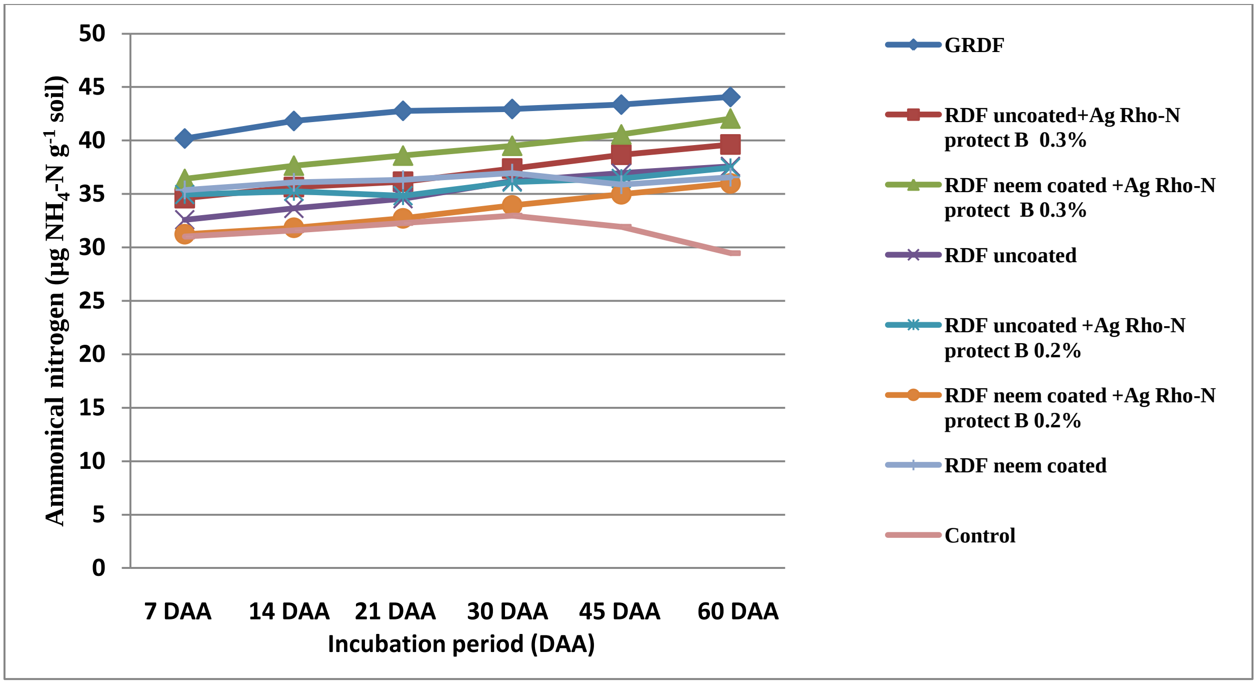


**Fig. 4.3 Effect of slow release nitrogenous fertilizer on ammonical nitrogen activity under incubation study**

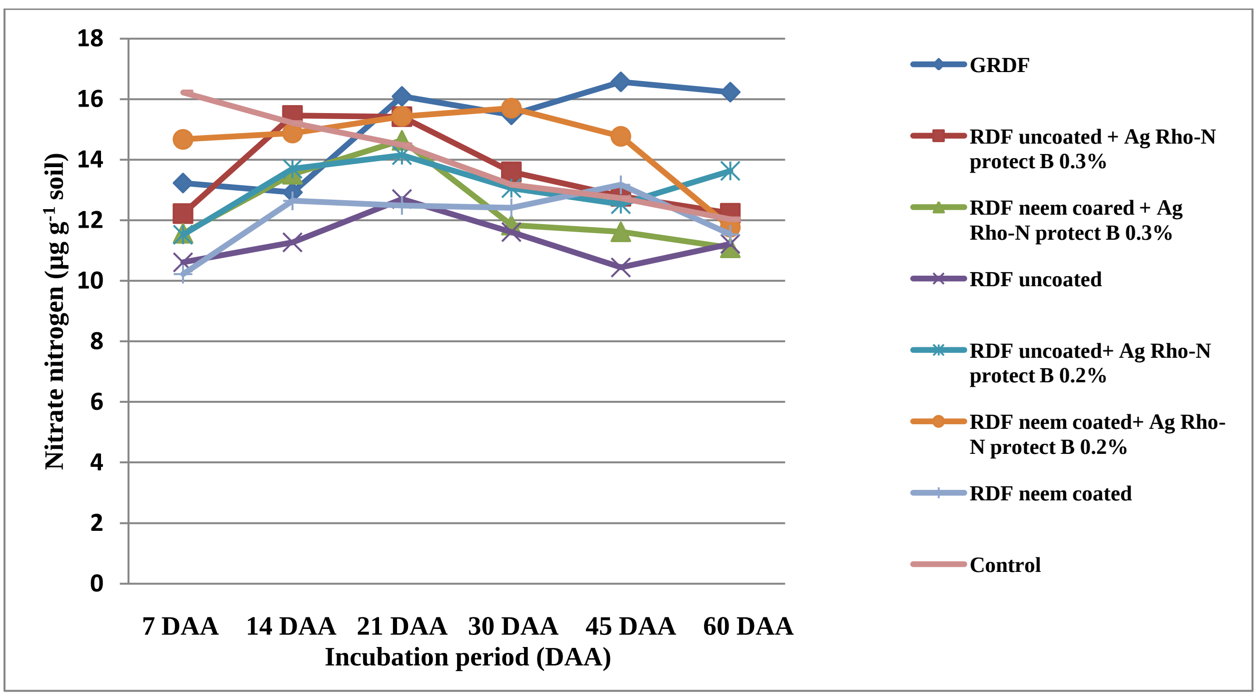


**Fig. 4.4 Effect of slow release nitrogenous fertilizer on nitrate nitrogen activity under incubation study**

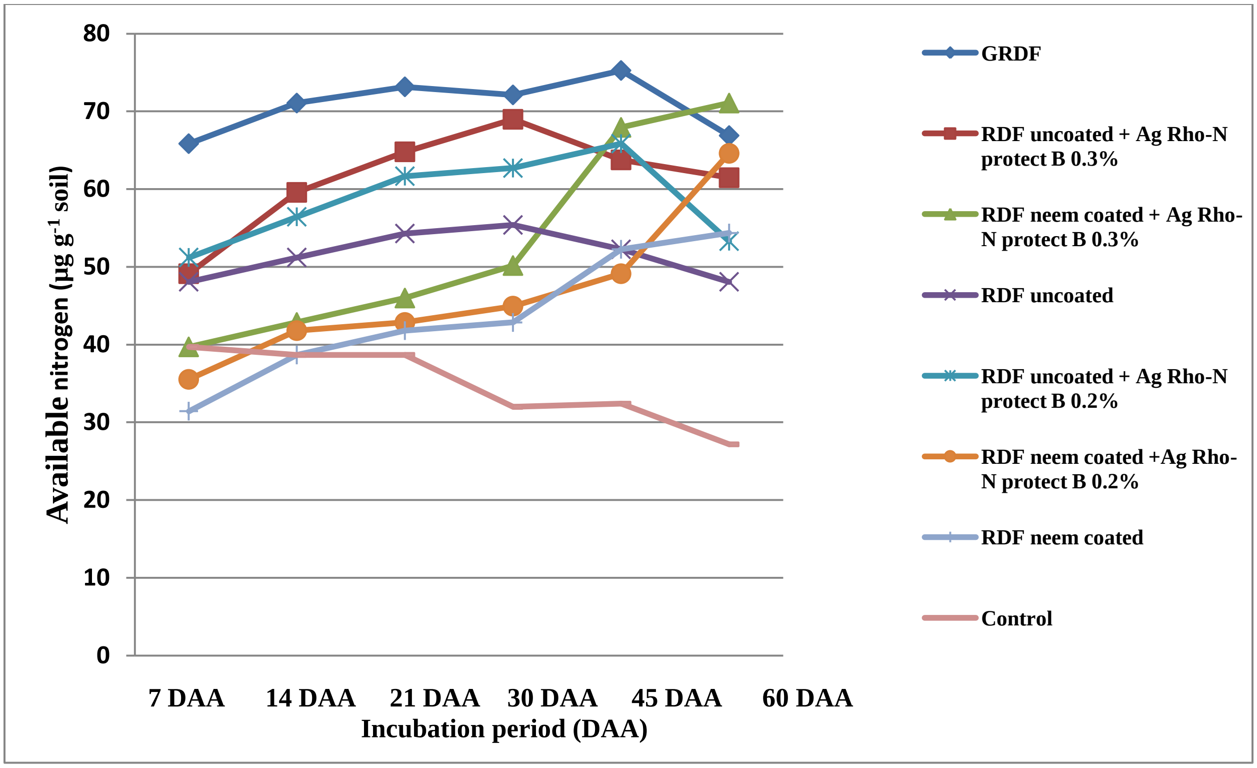


**Fig. 4.5 Effect of slow release nitrogenous fertilizer on available nitrogen activity under incubation study**

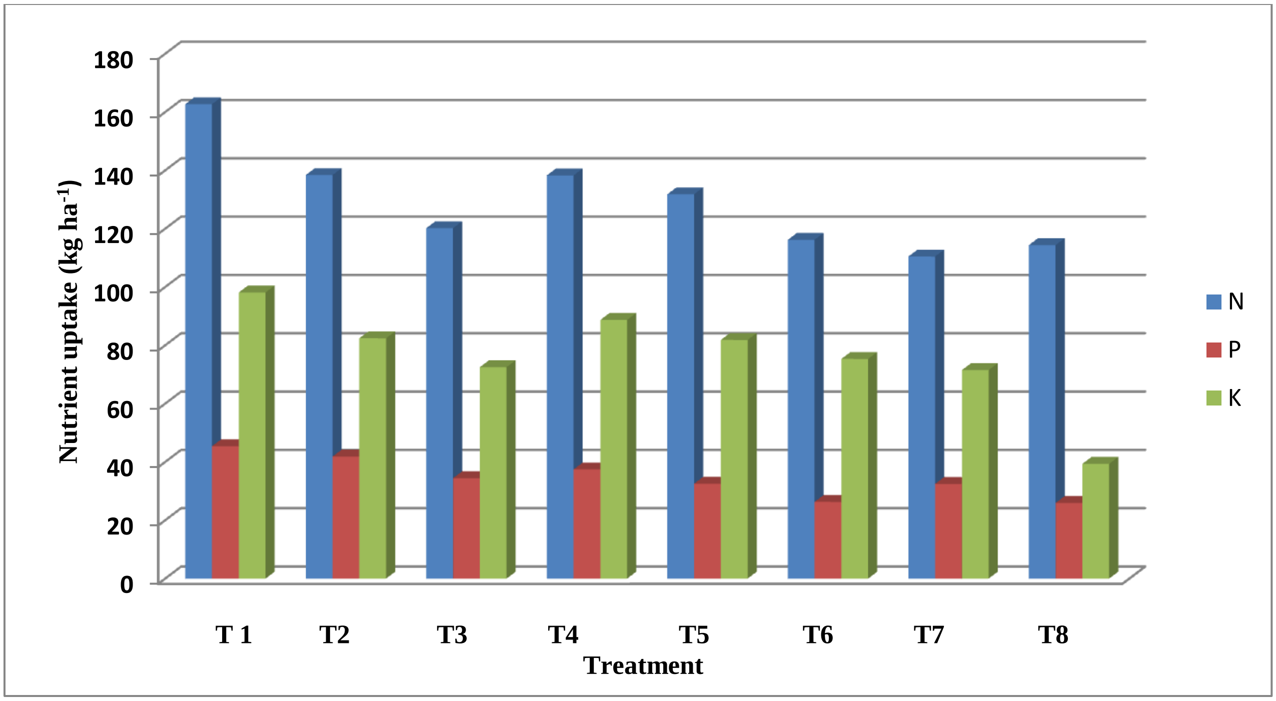


**Fig. 4.6 Effect of slow release nitrogenous fertilizer on nutrient uptake by preseasonal sugarcane**

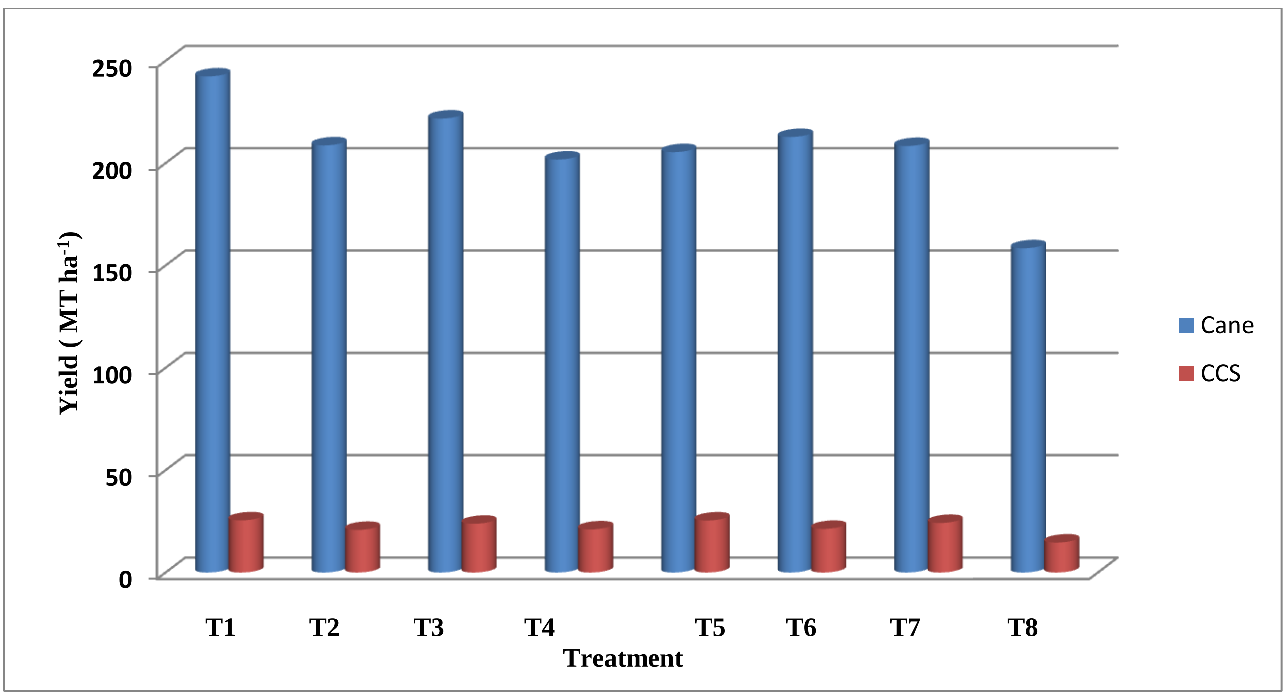


**Fig. 4.7 Effect of slow release nitrogenous fertilizer on yield by preseasonal sugarcane**

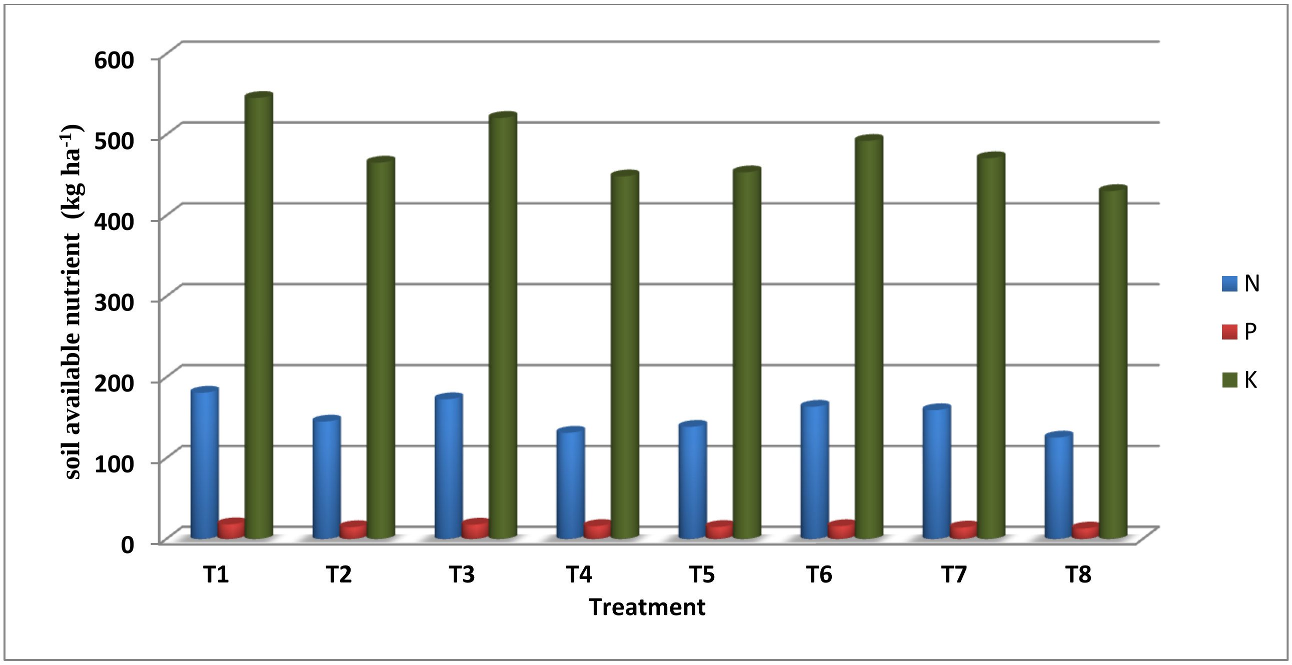


**Fig. 4.8 Effect of slow release nitrogenous fertilizer on soil available nutrient**

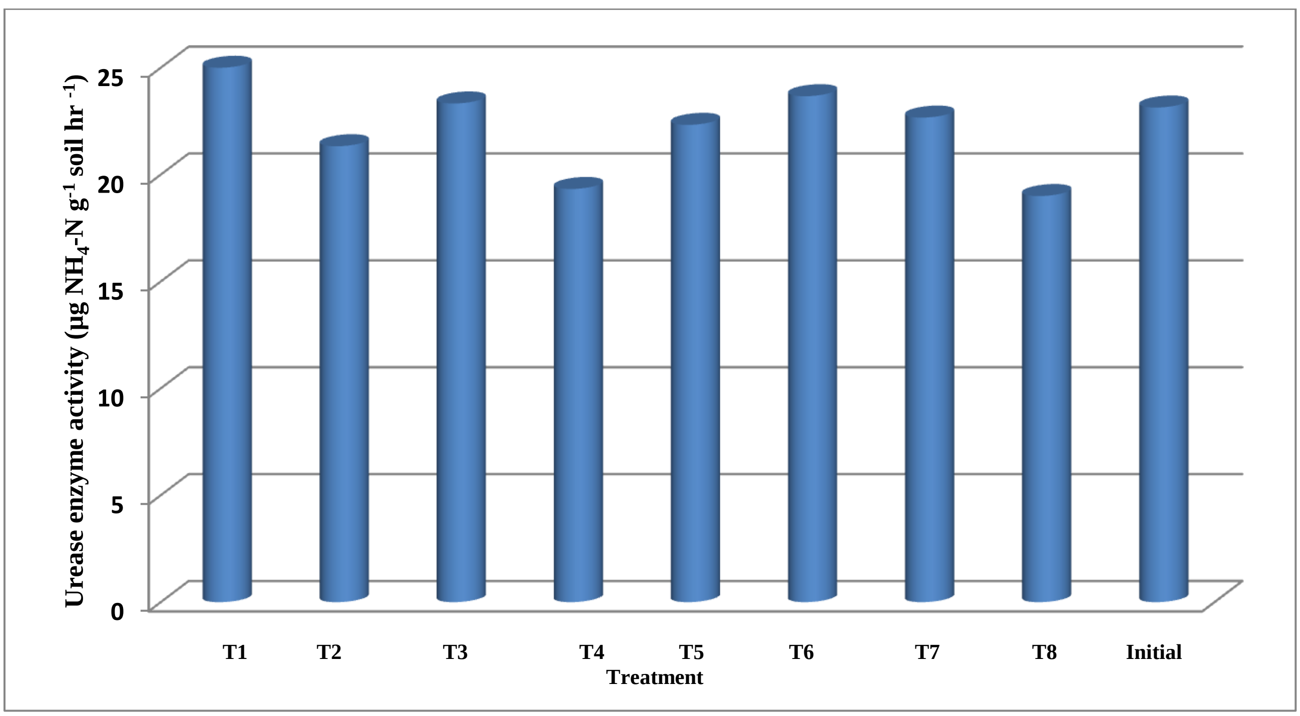


**Fig. 4.9 Effect of slow release nitrogenous fertilizer on urease enzyme activity**

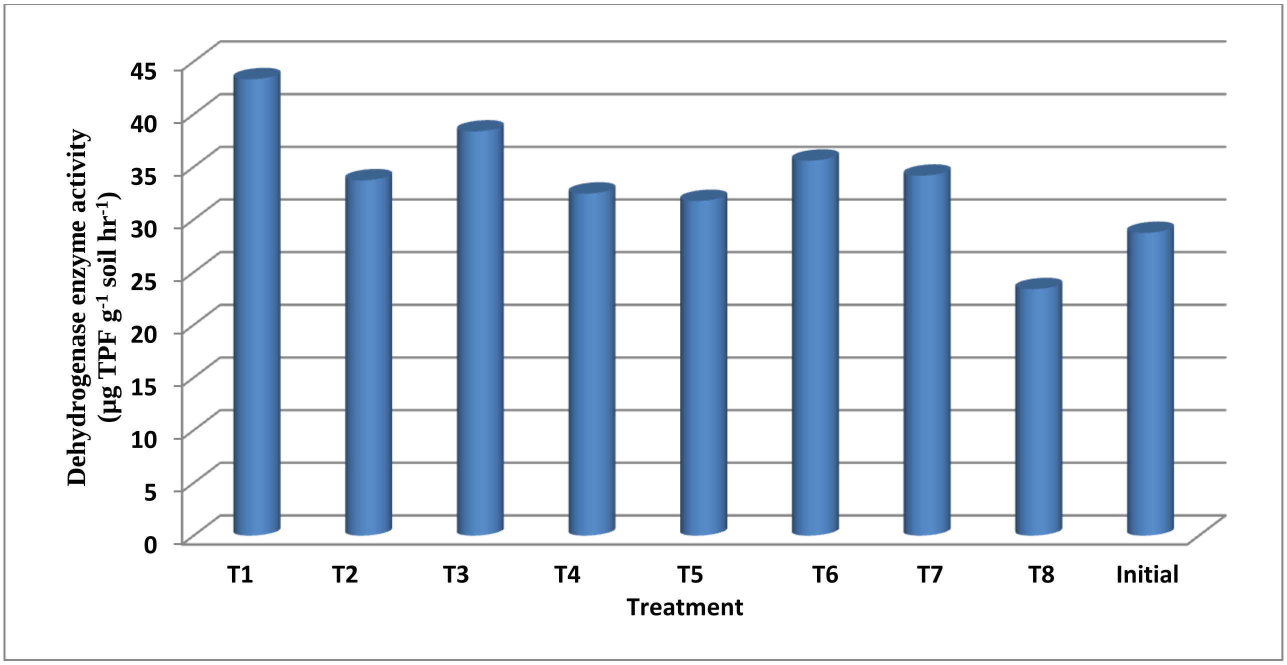


**Fig. 4.10 Effect of slow release nitrogenous fertilizer on dehydrogenase enzyme activity**

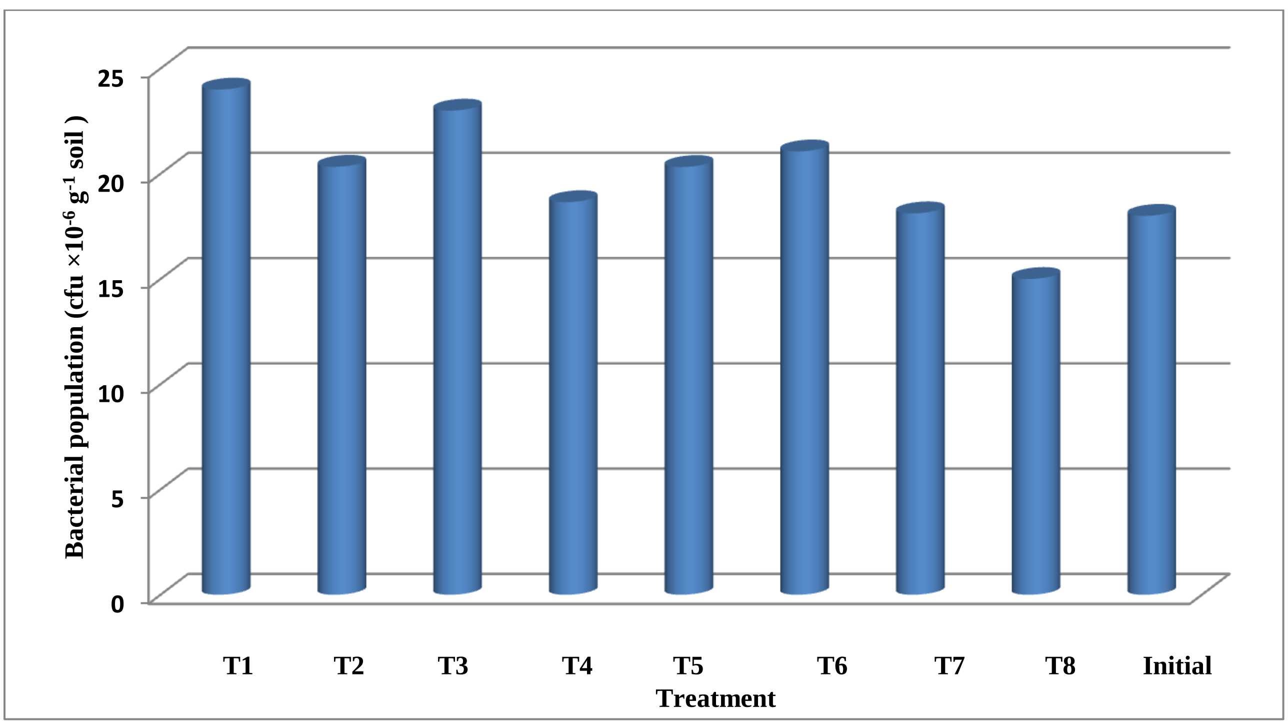


**Fig. 4.11 Effect of slow release nitrogenous fertilizer on soil bacterial population**

**N**

| | | | | | |
|---|---|---|---|---|---|
| $T_3$ | $T_7$ | $T_8$ | $T_6$ | $T_3$ | $T_8$ |
| $T_6$ | $T_4$ | $T_5$ | $T_2$ | $T_7$ | $T_2$ |
| $T_5$ | $T_8$ | $T_1$ | $T_7$ | $T_1$ | $T_4$ |
| $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_6$ |
| **R-I** | | **R-II** | | **R-III** | |

**Fig. 3.1 Layout of field experiment of preseasonal sugarcane**