**Nutrient uptake and Quality Parameters of cotton (*Gossypium hirsutum*) by using organic and inorganic nutrients with Phytohormone**

**Abstract**

~~In India, 6 million farmers directly depend on cotton for their income, while 40–50 million people are employed in the cotton trading and processing industry. In the twenty-first century, agriculture has faced several challenges in providing the food and fiber that the growing population need. By 2050, there will be nine billion people on the planet, making it more difficult for humans to meet their needs.~~

A field experiment was conducted in Farmer’s Field at Jayapuram Village, Natrampalli Taluk in Thirupathur District during Aug-Jan (2021-22) to investigate the effect of soil application of NPK fertilizers, Zn-enriched compost, and foliar spray of ZnO2 and NAA on enhancement of cotton nutrient uptake and quality in sandy loam soil.Fertilizers (N: P2O5: K2O) were sprayed at the appropriate dose (60:30:30 kg ha-1) using Urea, SSP, and MOP. Zn-enriched compost (Zn-EC) was ~~treated~~appliedat 1.0 t ha-1 as a basal one week before sowing. As per treatment ZnO2 at 0.1% was ~~applied~~sprayedtwice during the vegetative and blooming periods of the crop. The treatment included spraying NAA at 40 ppm twice during flowering and boll formation. Cotton *cv*. Sabari was cultivated as a test crop using suggested cultural methods. The study examined how different treatments affected nutrient uptake and quality parameters.

**Keywords:***Cotton, Zinc oxide, Enriched compost, NAA, Quality.*

**Introduction**

Cotton (*Gossypium hirsutum*) is an important commercial crop of India often referred toas “white gold” or “queen of fibers,” the most versatile cash crop which plays a distinguishable role in Indian economy as the country's textile industry is predominantly cotton based. India is one of the largest producers as well as exporters of cotton yarn and Indian textile industry contributes about 11 percent to industrial production, 14 percent to the manufacturing sector, 4 percent to the GDP and 12 per cent to the country's total export earnings.

The productivity of cotton in India is significantly lower (568 kg ha-1) as compared to the four major cotton growing countries *viz*., China (1300 kg ha-1), USA (900 kg ha-1),
Pakistan (700 kg ha-1) and Brazil (2047 kg ha-1) though India ranks first in area with
11.88 m ha-1, accounting 30 per cent of world coverage and 22 per cent (351 lakh bales of lint) of the world cotton production (second rank) with a productivity of 568 kg ha-1.The primary reasons for the low productivity of cotton are cultivation of crops predominantly under rain fed condition, use of less efficient cultivars, predominance of pests, excessive vegetative growth, boll shedding and inadequate supply of nutrients etc. (Patil *et al*. 2012 andJayakumar *et al*. 2014).

In Cotton, Nitrogen (N), controls growth and prevents abscission of squares and bolls, essential for photosynthetic activity and stimulates the mobilization and accumulation of metabolites in newly develop bolls thus increasing their number and weight.Phosphorus deficiency reduces the rate of leaf expansion and photosynthetic rate per unit leaf area.The physiological role of potassium (K) during fruit formation and maturation periods is mainly expressed in carbohydrate metabolism and translocation of metabolites from leaves and other vegetative organs to developing bolls.Zinc **(**Zn) is required in the biosynthesis of tryptophan, a precursor of the auxin - indole-3-acetic acid (IAA), which is the major hormone inhibiting abscission of squares and bolls.

The application of organic sources like manure application improved the soil physical properties especially soil texture, availability of nutrients like N, P and S as well as the micro nutrients and lower down the soil temperature and conserve the moisture (Jan *et al*. 2020)

NAA positively affects the plant growth and improves the maturity of cotton. In comparison with other natural auxin, NAA enhanced the weight and fiber elongation by hindering the secondary cell wall cellulose synthesis (Singh, 2009).

**Materials and Methods**

 The field experiment was conducted in Farmer’s Field at Jayapuram Village, Natrampalli Taluk in Thirupathur District during August, 2021-January, 2022 to investigate the effect of soil application of NPK fertilizers, Zn-Enriched compost, and foliar spray of ZnO2 and NAA on enhancement of cotton yield and quality in sandy loam soil. A randomised block design (RBD) with three replications was used in the experiment to ascertain how different sources of nutrients will affect how thecotton (*Gossypium hirsutum*) reacts.

 ~~List~~ 1: **Treatment details**

|  |  |  |
| --- | --- | --- |
| **S. No.** | **Treatment No.** | **Details** |
| 1 | T1 | Control |
| 2 | T2 | 100%RDF(N:P2O5:K2O)(60:30:30kgha-1) |
| 3 | T3 | 75%RDF+Zn-EC @1.0 t ha-1 |
| 4 | T4 | 75%RDF+ZnO2@ 0.1% |
| 5 | T5 | 75%RDF+NAA@ 40ppm |
| 6 | T6 | 75%RDF+Zn-EC @1.0 t ha-1+ZnO2@ 0.1% |
| 7 | T7 | 75%RDF+FS-ZnO2@ 0.1%(F.S)+NAA @ 40 ppm |
| 8 | T8 | 75%RDF+Zn-EC @1.0 t ha-1+NAA @40 ppm |
| 9 | T9 | 75%RDF+Zn-EC @1.0t ha-1+ZnO2@ 0.1%(F.S)+NAA@ 40 ppm |

##### PreparationofZincEnrichedCompost (Zn-EC)

~~Zn-enriched compost ()~~Zn-ECwas prepared by taking quantities of well decomposed FYM along with recommended quantity of ZnSO4@ 25 kg ha-1. This mixture kept under anaerobic condition for 4 weeks in a pit with a dimension of 90×90×90 cm. This mixture was sprinkled with water to maintain 65% moisture level. Thetopofthepitwassprinkledwithmudandincubatedforaperiodof45days.After45 days, the enriched compost was used for the field experiment. To protect composting mass from rainwater, the surface of the pit was covered by suitable polyethylene. Zinc solubilizing bacteria is also added with compost for the enrichment.

##### Fertilizerapplication

The recommended dose of fertilizers (N: P2O5: K2O) (60:30:30 kg ha-1) were applied to the field through Urea, SSP and MOP, respectively. Nitrogen was applied in two splits at 20 and 40 DAS. The full dose of P2O5and K2O weregiven as basal by band placement method. Based on the treatments, ~~Zn-enriched compost ()~~Zn-ECwas applied @ 1.0 t ha-1 as basal one week before sowing. As per treatment schedule, ZnO2@ 0.1% (Dissolve 0.1 g of Zinc oxide in 100 ml of water) was sprayed twice during vegetative and flowering stages of the crop. NAA @ 40 ppm was also sprayed as per the treatment twice during the flowering and boll formation stages of the cotton crop.

#### **QUALITYCHARACTERS OFTHE FIBRE**

##### Ginning percentage

#####  Itdenotestheratiooftheweightoflinttotheweightofseedcotton.Itisexpressed in percentage. Ginning percentage is calculated by using the formula.

Weightoflint(g)

Ginningpercentage = x 100

Weightofseedcotton(g)

##### LintIndex

#####  Theweightoflintobtainedfrom100seedcottonwasexpressedaslintindex. (Santhanam, 1976).

##### Seedindex

#####  Seedindexistheweightofseedsobtainedfrom100seedcotton(Santhanam, 1976).

##### Meanfibre length

#####  Themeanfibrelengthwasdeterminedby‘Bollsorter,’wheretheweightratiomethodwasadoptedand is expressedinmm.

##### Fibrefineness

#####  The weight per unit length (cm) of the fibre is generally taken as a measure of fineness.This was determined by air flow method using the micronaire instrument (Santhanam, 1976).

##### Fibrebundlestrength

#####  It is the ratio of the breaking strength of a fibre to its weight. Duplicate tufts of fibre weighing one mg were fed into the ‘pressley strength tester’ which gave reading in lb mg -1. The value was expressed in g tex-1 by multiflying the pressley strength index with 5.36 (Sundaram, 1974).

#### **PLANTANALYSIS**

#### **Plantsamplingand analysis**

####  Plant sample from various treatments in each replication were collected on 30,60, 90 and at harvest. The plants were cut at 2.5cm above the ground level and washed thoroughly with water to remove the adhering soil particles. The washed samples were shade dried followed by oven – dried at 60oC to a constant weight and then weighed to find out the dry matter production and expressed as kg ha-1.

####  After drying, the samples were cut into small pieces and ground in a Wiley mill and processed through one mm sieve and taken for analysis. Then powdered haulm plant sample was analysed for N, P, K, Zn and uptakes of respective nutrients were computed.

##### Uptakeof nutrients

The nutrient uptake *viz.,* N, P, K and Zn by cotton were calculated by using the following formula and expressed in kg ha-1

Nutrient uptake by plant (kg ha-1) = Nutrient content (%) x 100

DMP (kg ha-1)

##### Nitrogenuptake(kgha-1)

Nitrogen content in the plant samples was analysed by microkjeldhal method
(Yoshida *et al*., 1976). The nitrogen uptake was calculated by multiplying the total biomass with the nitrogen content and recorded in kg ha-1.

##### Phosphorusuptake(kgha-1)

The phosphorus content in the plant sample was determined by calorimetrically by using the triple-acid digestion method (Jackson, 1973). The phosphorus uptake was worked out by multiplying the total biomass with P content and recorded as kg ha-1.

**Zincuptake (mgkg-1)**

Zinccontent in plantsampleswas estimatedbytheDTPA extractmethod andthe values were recorded by using Atomic Absorption Spectrophotometer (AAS) (Lindsay and Norvell, 1978). The zinc uptake was worked out by multiplying the total biomass with Zn content in plant and recorded as mg kg-1.

**Results and discussion**

#### **QUALITYCHARACTERISTICSOF COTTON**

##### Ginning percentage

#####  The data pertaining to ginning percentage, seed index and lint index with different treatments are given in table 2.~~There was~~A non-significant differencewas observed between treatments and ginningpercentageofcotton.Amongthedifferenttreatments,applicationof75%RDF+ Zn-EC @ 1.0 t ha-1+ ZnO2@ 0.1%+ NAA @ 40 ppm (T9) showed highest ginning percentage(34.05%).~~However,~~Controltreatmentregistered lowestginningpercentageof32.60%. There was a non-significant difference between treatments and quality characteristics of cotton. The highest ginning percentage of 34.05% recorded with 75%RDF + Zn-EC @ 1.0 tha-1 + ZnO2 @ 0.1%+ NAA @ 40ppm (T9) while lowest ginning percentage (32.60) observed in control (T1).Nitrogen deficiency had more impact over seed than lint growth, thus low seed weight resulted in higher ginning percentage (Tewolde *et al*. 2007). Ginning percentage is not significantly influenced by spraying of NAA@ 40 ppm. Similar results were reported by Rajendran *et al*. (2011).

##### Seedindex

#####  Theresultsrevealed~~that,therewasa~~non-significantdifferenceamongtreatments forseedindex.ThetreatmentsT1,T2,T3andT4recordedtheseedindexof8.45,8.99, 8.66 and 8.54 which were ~~received~~ control, 100% RDF, 75% RDF + Zn EC@ 1.0 t ha-1and75% RDF + ZnO2@ 0.1%, respectively. Application of 75% RDF + Zn– EC @ 1.0tha-1+ZnO2@ 0.1%+ NAA@ 40 ppm (T9)registered highest seed index of9.13 which was higher compared to other treatments. There is a non-significant difference were observed between the treatments. Application of 75% RDF + Zn EC @ 1.0 t ha-1+ ZnO2 @ 0.1%+ NAA @ 40 ppm (T9) recordedthehighestseedindex(9.13)anditwasfoundtobeonparwith(T2) 100% RDF (N:P2O5:K2O) (60:30:30 kg ha-1).The highest seed index recorded in inorganic fertilizers with zinc enriched compost might be due to supply of judicious amount of nutrient at all growth stages as well as activation of various enzymes that regulate different biochemical reactions, assimilation of photosynthetic product in to reproductive parts which lead to increased flowering and seed index in cotton. Similar results were also reported by Yadav and Poonia (1996). Seed index is not significantly influenced by spraying of NAA @ 40 ppm alone. Similar finding was observed by Rajendran *et al*. (2011).

##### Lintindex

#####  A ~~similar~~ trend similartoseed index was also observed in lint index ~~with~~ ~~seed index~~due to different treatments. Application of 75% RDF + Zn – EC @ 1.0 t ha-1+ ZnO2@ 0.1%+ NAA @ 40 ppm(T9)registeredhighestlintindexof4.20. The treatment control (T1) registered the lowest lint index (3.96) compared to other treatments. Thehighestlintindexof4.20wasfoundtobewith75%RDF+ZnEC@1.0 t ha-1 + ZnO2@ 0.1%+ NAA @ 40 ppm (T9). The improvement in lint index might be due to the combined application of inorganic fertilizer (macro and micro nutrients) and zinc-enrichedcompost.

**Table1.**Effectofinorganicfertilizers,Zn-enrichedcompost,andphyto-hormoneon quality characteristics of cotton *cv*. Sabari

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatment No.** | **TreatmentDetails** | **Ginning (%)** | **Seed index** | **Lint index** |
| T1 | Control | 32.60 | 8.45 | 3.96 |
| T2 | 100%RDF(N:P2O5:K2O)(60:30:30 kgha-1) | 34.00 | 8.99 | 4.16 |
| T3 | 75%RDF+Zn EC@ 1.0t ha-1 | 33.09 | 8.66 | 4.02 |
| T4 | 75%RDF+ZnO2@ 0.1% | 32.81 | 8.54 | 3.99 |
| T5 | 75%RDF+NAA@ 40 ppm | 33.38 | 8.76 | 4.05 |
| T6 | 75%RDF+Zn EC @ 1.0t ha-1+ZnO2@0.1% | 33.40 | 8.81 | 4.07 |
| T7 | 75%RDF+ZnO2@0.1%+NAA@40 ppm | 33.59 | 8.86 | 4.10 |
| T8 | 75%RDF+Zn EC@ 1.0t ha-1+NAA@40 ppm | 33.94 | 8.94 | 4.14 |
| T9 | 75%RDF+Zn EC@ 1.0t ha-1+ZnO2@0.1%+ NAA@40ppm | 34.05 | 9.13 | 4.20 |
| **S. Ed** |  | **1.32** | **0.34** | **0.16** |
| **CD (P=0.05)** |  | **NS** | **NS** | **NS** |

**Fibrelength (mm)**

The data pertaining to Fibre length, fibre fineness and fibre bundle length with different treatments are given in table 3. The fibre length varied from 29.29 to 30.44 mm due to different treatments. The results revealed ~~that there was~~a non - significance difference ~~was noticed~~between the treatmentsandfiberlengthofcotton.Amongthetreatments,applicationof75%RDF+ Zn – EC @ 1.0 t ha-1+ ZnO2 @ 0.1% + NAA @ 40 ppm (T9) recorded highest fibrelengthof30.44mm.Phosphorus had no consistent role over fibre properties (Malik and Iqbal Makhdum, 1992). However, lowest fibre length of 29.29 mm was observed in control (T1) whichwasreceivednoinorganicfertilizersi.e.,zincenrichedcompostand phyto-hormone.

**Fibre fineness**

Micronaire values were recorded to study the fibre fineness of cotton due to different treatments. The fibre fineness ranged from 3.94 to 4.20 ~~due to different treatments~~. There was a non-significant difference ~~was observed~~due to treatments for fibrefineness. However,lowestfibrefineness of3.94 mm wasfound to be with control (T1).This was because fibre quality is more of a genetic character.Nitrogensourceshadonlyminimalornoeffectoverfibrequality(Watts *et al.* 2017).

**Fibrebundle strength**

The data on fibrebundlestrengthduetodifferenttreatmentswasnon-significant. It ~~is~~wasranged from 24.25 to 26.61 g tex-1. Soil application of 75% RDF, zinc enriched compost @ 1.0 t ha-1and foliar spray of ZnO2@ 0.1%+ NAA @ 40 ppm (T9)registeredhighestfibrebundlestrengthof26.61gtex-1.However lowest fibre bundlestrength noticed incontrol (T1) (24.25). This was conformity with the present findings. This was conformity with the present findings. The quality characters were mostly governed by genetic makeup of cotton plant and they were not changed by spraying of chemicals(Rajendran *et al*.2011).

**Table2.**Effectofinorganicfertilizers,Zn-enrichedcompostandphyto-hormoneon quality characteristics of cotton cv. Sabari

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatment No.** | **TreatmentDetails** | **FibreLength (mm)** | **Fibre fineness (µg/inch)** | **Fibrebundle strength (g tex-1)** |
| T1 | Control | 29.29 | 3.94 | 24.25 |
| T2 | 100%RDF(N:P2O5:K2O)(60:30:30 kgha-1) | 30.16 | 4.13 | 26.03 |
| T3 | 75%RDF+Zn EC@ 1.0t ha-1 | 29.05 | 3.99 | 24.90 |
| T4 | 75%RDF+ZnO2@ 0.1% | 29.41 | 3.96 | 24.57 |
| T5 | 75%RDF+NAA@ 40 ppm | 29.69 | 4.04 | 25.21 |
| T6 | 75%RDF+Zn EC @ 1.0 t ha-1+ZnO2@0.1% | 29.50 | 4.05 | 25.44 |
| T7 | 75%RDF+ZnO2@0.1%+NAA@40 ppm | 29.63 | 4.09 | 25.75 |
| T8 | 75%RDF+Zn EC@ 1.0t ha-1+NAA@40 ppm | 30.23 | 4.16 | 26.27 |
| T9 | 75%RDF+Zn EC@ 1.0t ha-1+ZnO2@0.1%+NAA@40ppm | 30.44 | 4.20 | 26.61 |
| **S. Ed** |  | **1.18** | **0.16** | **1.00** |
| **CD (P=0.05)** |  | **NS** | **NS** | **NS** |

**Nitrogenuptake(kgha-1)**

 Nutrient uptake is the product of dry matter production and nutrient content. The growth and yield attributes of cotton crop is directly related to uptake of NPK. Nutrient uptake primarily depends on dry matter production and nutrient concentration in plants. Increased photosynthesis has resulted in higher DMP and in turn higher nutrient uptake. Application of inorganic fertilizers, zinc-enriched compost and phyto-hormone significantlyinfluencedthenitrogenuptakebycotton. Applicationof75%RDF+ZnEC @1.0 t ha-1+ZnO2 @ 0.1%+NAA @ 40 ppm (T9)recorded thehighest N uptake (70.15 kgha-1at harvest)by cotton.Theincreasein Nuptakemightbeduetohigheravailability of nitrogen in soil and direct addition of nitrogen through compost and greater accumulation of soil microbes, which could convert organically bound nitrogen into inorganic form.Furthermore,addedorganicsimprovedtheorganiccarboncontentinsoil throughdecomposition,whichhelpedinthereleaseoforganicallyboundmacronutrients in soil.

 Application of zinc also been reported to increase concentration and uptake of nitrogen through synergetic interaction between these two nutrients. The increase in N uptake by crops due to application of compost might be due to the enzymatic effects in metabolic process (Singh *et al*.1978). Nutrient uptake especially N is mostly dependent on seed yield level, which is the major sink for these nutrients.

 Zn enriched compost during decomposition release nutrients which became available to the plants and thus increased NPK content. Further, integrated application of plant nutrients resulted in more uptakes of them as compared to sole use of organic or inorganic or bio-fertilizer alone and control. This might be ~~due to the fact that~~because ofbalanced and combined use of various plant nutrient sources resulting in proper absorption, translocation and assimilation of those nutrients, ultimately increasing the dry matter accumulation and nutrient contents of plant and thus showing more uptake of NPK nutrients.SimilarfindingswerereportedbyTyagi*etal*.(2014)andKalaiyarasi *et al*. (2019).

**Table3.**Effectofinorganicfertilizers,Zn-enrichedcompostandphyto-hormoneon nitrogen uptake (kg ha-1)by cotton *cv*. Sabari at different stages

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatment No.** | **TreatmentDetails** | **30****DAS** | **60****DAS** | **90****DAS** | **At Harvest** |
| T1 | Control | 4.73 | 16.64 | 25.84 | 40.60 |
| T2 | 100%RDF(N:P2O5:K2O)(60:30:30 kgha-1) | 7.48 | 36.19 | 58.51 | 65.89 |
| T3 | 75%RDF+Zn EC@ 1.0t ha-1 | 5.92 | 25.14 | 38.73 | 49.91 |
| T4 | 75%RDF+ZnO2@ 0.1% | 5.46 | 21.25 | 33.12 | 45.67 |
| T5 | 75%RDF+NAA@ 40 ppm | 6.39 | 29.16 | 44.68 | 54.64 |
| T6 | 75%RDF+Zn EC @ 1.0t ha-1+ZnO2@0.1% | 6.52 | 30.81 | 45.49 | 55.93 |
| T7 | 75%RDF+ZnO2@0.1%+NAA@40 ppm | 6.97 | 31.57 | 51.55 | 61.26 |
| T8 | 75%RDF+Zn EC@ 1.0t ha-1+NAA@40 ppm | 7.62 | 35.21 | 57.24 | 66.09 |
| T9 | 75%RDF+Zn EC@1.0t ha-1+ZnO2@0.1%+ NAA@40ppm | 8.11 | 39.70 | 64.19 | 70.15 |
| **S. Ed** |  | **0.23** | **1.62** | **2.45** | **1.12** |
| **CD (P=0.05)** |  | **0.45** | **3.18** | **4.86** | **2.25** |

**Phosphorusuptake(kgha-1)**

 In the present study, phosphorus uptake by cotton crop was significantly influenced with inorganic fertilizers, zinc enriched compost and phyto-hormone. Application of 75%RDF + Zn EC@1.0 tha-1+ ZnO2@0.1%+ NAA@40ppm (T9) recorded the highest P uptake (29.86 kg ha-1 at harvest) by cotton. Phosphorous is thekey element for cotton growth and yield. Cotton plants utilize about 7 to 10 kg of P2O5per bale of lint. Cotton seed is the highest reservoir containing about half the total plant phosphorus. Phosphorus mobility is the prime limitation to its uptake by cotton plants. It does not move in soil water, so cotton roots, must reach phosphate ions for their utilization. Cotton roots are aided in intercepting soil phosphorus by mycorrhizal fungi, making cotton highly dependent on mycorrhizae for phosphorus uptake. Similar findings were observed by Malik (1998). Thehigher phosphorusuptake was also due to adequate and steady availability of nutrients throughout the crop growth period due to mineralization and slow release of nutrients to cotton crop resulting in to higher uptake of nutrients with the increased dry matterproductionandseedcottonyield.SimilarfindingswereobservedbyVani *et al*. (2020).

 Nutrient uptake especially phosphorus is mostly dependent on seed yield, whichis the major sink for these nutrients. Therefore, greater productivity of compost and balanced fertilizer plots contributed to greater nutrient removal than control plots. These results are in conformity with Blaise *~~et al~~*~~.~~and Prasad(2005). The ~~highest~~higherphosphorus uptake by cotton might be also due to application of NPK, Zn enriched compost and foliar spray of NAA increased the absorption power of the soil for cations and anions, particularly nitrogen and phosphate. These ions are released gradually during entire growing period of the crop which might have increased concentration as well as improved plant growth and accumulation of greater biomass which helped to increase nutrients uptake. The present study is in line with Ghosh and Das (2011).

**Table4.**Effectofinorganicfertilizers,Zn-enrichedcompostandphyto-hormoneon phosphorus uptake (kg ha-1) by cotton *cv.* Sabari at different stages

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatment No.** | **TreatmentDetails** | **30****DAS** | **60****DAS** | **90****DAS** | **At Harvest** |
| T1 | Control | 1.24 | 5.24 | 10.51 | 12.71 |
| T2 | 100%RDF(N:P2O5:K2O)(60:30:30kgha-1) | 2.26 | 15.19 | 23.04 | 27.25 |
| T3 | 75%RDF+Zn EC@ 1.0t ha-1 | 1.64 | 8.68 | 15.73 | 15.60 |
| T4 | 75%RDF+ZnO2@ 0.1% | 1.36 | 6.95 | 13.89 | 18.47 |
| T5 | 75%RDF+NAA@ 40 ppm | 1.78 | 10.40 | 17.77 | 21.43 |
| T6 | 75%RDF+Zn EC @ 1.0tha-1+ZnO2@0.1% | 1.85 | 11.54 | 17.82 | 22.28 |
| T7 | 75%RDF+ZnO2@0.1%+NAA@40 ppm | 2.04 | 13.33 | 20.48 | 24.64 |
| T8 | 75%RDF+Zn EC@ 1.0t ha-1+NAA@40 ppm | 2.34 | 15.31 | 23.15 | 27.31 |
| T9 | 75%RDF+Zn EC@ 1.0t ha-1+ZnO2@0.1%+NAA@40ppm | 2.62 | 18.17 | 24.67 | 29.86 |
| **S. Ed** |  | **0.09** | **0.66** | **0.46** | **0.72** |
| **CD (P=0.05)** |  | **0.18** | **1.32** | **0.93** | **1.45** |

##### Potassiumuptake(kgha-1)

#####  Potassium uptake by cotton was significantly influenced by the application of inorganic fertilizers, zinc enriched compost and phyto-hormone. Applicationof75%RDF+Zn EC@ 1.0tha-1+ZnO2@0.1%+NAA @ 40ppm (T9) recorded the highest K uptake by cotton (61.67 kg ha-1 at harvest). However lowest K uptake of 37.24 kg ha-1was recorded in the treatment control (T1). Potassium supplied adequate quantity of nutrients to coincide with peak demand for nutrients to cotton. Besides, the external application of K might have increased the quantity of readily available K to cotton thus resulting in higher K uptake. These results are in conformity with the findings of Srinivasan (2003). The higher nutrient uptake with organic manure might be attributed to solubilization of native nutrients, chelation complex of intermediate organic molecules produced during decomposition of added manures with nutrients their mobilization and accumulation of nutrients in different plant parts (Chesti*et al*. 2015). This was also might be due to attributed to improved utilization of N in the presence of K and availability of nutrients at growth stage when cotton crop starts growing faster. These results are in line with the findings of Bhati and ~~Manpreet~~Singh, 2015).

**Table5.**Effectofinorganicfertilizers,Zn-enrichedcompostandphyto-hormoneon potassiumuptake (kg ha-1) by cotton*cv*. Sabari at different stages

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatment No.** | **TreatmentDetails** | **30****DAS** | **60****DAS** | **90****DAS** | **At Harvest** |
| T1 | Control | 4.15 | 12.19 | 22.46 | 37.24 |
| T2 | 100%RDF(N:P2O5:K2O)(60:30:30 kgha-1) | 6.42 | 26.85 | 40.12 | 57.18 |
| T3 | 75%RDF+ZnEC@ 1.0t ha-1 | 4.70 | 17.68 | 30.14 | 45.08 |
| T4 | 75%RDF+ZnO2@ 0.1% | 5.11 | 14.43 | 25.89 | 40.97 |
| T5 | 75%RDF+NAA@ 40 ppm | 5.49 | 20.82 | 33.49 | 48.79 |
| T6 | 75%RDF+Zn EC @ 1.0t ha-1+ZnO2@0.1% | 5.68 | 21.99 | 34.38 | 49.84 |
| T7 | 75%RDF+ZnO2@0.1%+NAA@40 ppm | 6.06 | 24.44 | 37.17 | 53.61 |
| T8 | 75%RDF+Zn EC@1.0t ha-1+NAA@40 ppm | 6.53 | 27.16 | 40.26 | 58.09 |
| T9 | 75%RDF+Zn EC@ 1.0t ha-1+ZnO2@0.1%+NAA@40ppm | 6.92 | 29.74 | 43.50 | 61.67 |
| **S. Ed** |  | **0.10** | **1.00** | **0.70** | **0.99** |
| **CD (P=0.05)** |  | **0.21** | **1.86** | **1.36** | **1.98** |

##### Zincuptake(gkg-1)

#####  In the present study, zinc uptake by cotton was significantly influenced with the application of inorganic fertilizers, zinc-enriched compost and phyto-hormone. Applicationof75%RDF+Zn EC@ 1.0tha-1+ZnO2 @0.1%+NAA @ 40ppm (T9) recorded the highest Zn uptake by cotton (178.8 g ha-1). However lowest Zn uptake (122.4 g ha-1) was recorded incontrol (T1). The increased uptake of Zn by the application of ZnO2and Zn-Enriched compost might ~~be~~ attributed to the increased root biomass and increased availability of Zn in soil. The application of compost with zinc resulted in higher Zn availability due to mineralization of organic manures. Thus, zinc enriched compost application could result in release of more nutrients in easily available form which would directly affect the uptake of zinc by cotton. Similar results were reported by Chitdeshwari and Poongothai, 2003. The increase in zinc uptake might be attributed to improved zinc availability in soil as organics that facilitates higher activity of zinc in soil solution and enhance thezinc uptake through mass flow and diffusion. Zinc enriched compost on decay produce a variety of biochemical substances (organic manure, poly phenols, amino acids and polysaccharides) which stimulate the solubility, transport and availability of Zn in soil (Prasad *et al*. 2010). Addition of zinc enriched compost resulted in higher micronutrient availability like Zn due to mineralization according to Mali *etal*. (2015). This was alsomight be due totheapplicationofzincenrichedcompostresultedinreleaseofmoremicronutrientsin easily available form which reflected in overall growth and uptake of nutrients. These results are in accordance with the earlier reports of Mohanty*et al*. (2015).

##### Addition of zinc enriched compost caused higher Zn uptake mainly due to beneficial effect in mobilizing the native nutrient to increase the availability besides addition of Zn-enriched organics to the soil by naturally chelated form. This might have causedbetterZnnutritionoveralonger

##### period to cause better growth (Gupta et al., 2002).

**Table6.**Effectofinorganicfertilizers,Zn-enrichedcompostandphyto-hormoneon zinc uptake (gha-1) by cotton *cv*. Sabari at different stages

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatment No.** | **TreatmentDetails** | **30****DAS** | **60****DAS** | **90****DAS** | **At Harvest** |
| T1 | Control | 12.4 | 38.4 | 72.3 | 122.4 |
| T2 | 100%RDF(N:P2O5:K2O)(60:30:30kgha-1) | 13.9 | 50.3 | 76.5 | 131.1 |
| T3 | 75%RDF+Zn EC@ 1.0t ha-1 | 15.4 | 58.2 | 81.3 | 145.6 |
| T4 | 75%RDF+ZnO2@ 0.1% | 15.8 | 59.0 | 83.9 | 144.0 |
| T5 | 75%RDF+NAA@ 40 ppm | 13.5 | 48.7 | 76.0 | 132.4 |
| T6 | 75%RDF+ZnEC@1.0tha-1+ZnO2@0.1% | 18.6 | 72.3 | 93.7 | 169.3 |
| T7 | 75%RDF+ZnO2@0.1%+NAA@40 ppm | 17.8 | 66.1 | 89.6 | 158.9 |
| T8 | 75%RDF+Zn EC@ 1.0 t ha-1+NAA@40ppm | 17.1 | 65.6 | 88.2 | 156.1 |
| T9 | 75%RDF+Zn EC@ 1.0t ha-1+ZnO2@0.1%+ NAA@40ppm | 19.8 | 79.2 | 98.4 | 178.8 |
| **S. Ed** |  | **0.33** | **1.25** | **1.70** | **3.03** |
| **CD (P=0.05)** |  | **0.65** | **2.48** | **3.41** | **6.04** |

#### **CONCLUSION**

#### Considering the salient findings in perspective, the present investigation clearly concluded that 75% RDF + Zn EC @ 1.0 t ha-1+ ZnO2@ 0.1%+ NAA @ 40 ppm (T9) was the best treatment for enhancing quality and nutrient uptake by cotton cv. Sabari. This was followed by 75% RDF+ Zn EC @1.0 t ha-1+ NAA @ 40 ppm (T8), which was ~~on~~atpar with 100% RDF (T2). It is also concluded that soil application of 75% recommended NPK, zinc enriched compost @ 1.0 t ha-1and foliar spray of ZnO2@ 0.1% and NAA @ 40 ppm is an economical and feasible practice for the farmers for improving the yield and qualityof cotton grown in sandy loam soil. The same treatment also enhanced the soil health of sandy loam soil in terms of physical, chemical, biological properties and nutrients availability.

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