

**EVALUATION OF GENOTYPES AND NITROGEN LEVELS FOR  
YIELD MAXIMIZATION IN *rabi* MAIZE  
(*Zea mays* L.,)**

**By**

**O.SAMPATH  
B.Sc. (Ag.)**

THESIS SUBMITTED TO  
ACHARYA N. G. RANGA AGRICULTURAL UNIVERSITY  
IN PARTIAL FULFILMENT OF THE REQUIREMENTS  
FOR THE AWARD OF THE DEGREE OF

**MASTER OF SCIENCE IN AGRICULTURE  
(AGRONOMY)**



**DEPARTMENT OF AGRONOMY  
COLLEGE OF AGRICULTURE  
ACHARYA N. G. RANGA AGRICULTURAL UNIVERSITY  
RAJENDRANAGAR, HYDERABAD-500 030.**

**JULY, 2009**

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**JULY, 2009**

## **DECLARATION**

I, **Mr.O.SAMPATH** hereby declare that the thesis entitled “**EVALUATIO OF GENOTYPES AND NITROGEN LEVELS FOR YIELD MAXIMIZATION IN RABI MAIZE (*Zea mays* L.)**” submitted to Acharya N.G. Ranga Agricultural University for the degree of **MASTER OF SCIENCE IN AGRICULTURE** majoring in **AGRONOMY** is the result of original research work done by me. I also declare that the materials contained in this thesis have not been published earlier.

Date:  
Place: Rajendranagar  
Hyderabad

**(O.SAMPATH)**

## **CERTIFICATE**

**Mr.O.SAMPATH** has satisfactorily prosecuted the course of research and that the thesis entitled “**EVALUATION OF GENOTYPES AND NITROGEN LEVELS FOR YIELD MAXIMIZATION IN RABI MAIZE (*Zea mays L.*)**” submitted is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that the thesis or part thereof has not been previously submitted by her for a degree of any university.

**Date:**

**(Dr.M.MADHAVI)**

**Place:** Hyderabad

**Major Advisor**

## CERTIFICATE

This is to certify that the thesis entitled “**EVALUATION OF GENOTYPES AND NITROGEN LEVELS FOR YIELD MAXIMIZATION IN RABI MAIZE(ZEA MAYS L.)**” submitted in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE IN AGRICULTURE** of the **Acharya N.G. Ranga Agricultural University, Hyderabad**, is a record of the bonafide research work carried out by **Mr. O.SAMPATH** under our guidance and supervision. The subject of the thesis has been approved by the Student’s Advisory Committee.

No part of the thesis has been submitted for any other degree or diploma. The published part has been fully acknowledged. All assistance and help received during the course of the investigation have been duly acknowledged by the author of the thesis.

**(Dr. M.MADHAVI)**

(Chairman of the Advisory Committee)

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(O.SAMPATH).....

## LIST OF SYMBOLS AND ABBREVIATIONS

%	:	Per cent
@	:	At the rate of
°C	:	Degree centigrade
CD	:	Critical difference
cm	:	Centimeter
DAS	:	Days after sowing
dSm <sup>-1</sup>	:	Deci siemen per meter
<i>et al.</i> ,	:	And others
Fig.	:	Figure
g	:	Gram
h	:	Hours
k	:	Potassium
Kg ha <sup>-1</sup>	:	Kilograms per hectare
LAI	:	leaf area index
m	:	Metre
mm	:	milli meter
N	:	nitrogen
P	:	phosphorus
Rs ha <sup>-1</sup>	:	Rupees per hectare
S.Em ±	:	Standard error of mean
<i>viz.</i> ,	:	namely

## ABSTRACT

Name of the Author : O.SAMPATH  
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A field experiment entitled “Evaluation of genotypes and nitrogen levels for yield maximization in *rabi* maize (*Zea mays* L.)” with three hybrids viz., BH 1576, Super 900 M and BH 1576 as main treatments and four nitrogen levels (150,200 ,250 and 300 kg N ha<sup>-1</sup> ) each replicating three times in a split spot design was conducted during *rabi* 2008-09 on sandy loam soils of College Farm, College of Agriculture, Rajendranagar , Hyderabad.

The results indicated that hybrids BH 40625, Super 900 M and BH 1576 performed almost alike regarding all the growth parameters, yield attributes, grain yield, nutrient uptake and protein content.

All the growth parameters except number of green leaves plant<sup>-1</sup>, yield attributes, grain yield, nutrient uptake and protein content in grain increased significantly with each higher level of nitrogen up to 200 kg N ha<sup>-1</sup> Application of 300 kg N ha<sup>-1</sup> did not prove to advantageous over 200 kg N ha<sup>-1</sup> .

The interaction between hybrids and nitrogen levels were found to be significant only incase of Leaf area index, protein content, nutrient uptake of N P K. A maximum grain yield of 7.0 t ha<sup>-1</sup> was obtained with the application 300 kg ha<sup>-1</sup>. Where as hybrid BH 40625 recorded 6.7 t ha<sup>-1</sup> in comparison to Super 900 M ( 6.5 t ha<sup>-1</sup>) and BH 1576 ( 6.4 t ha<sup>-1</sup> )

Post harvest soil available nitrogen, available phosphorus ( $P_2O_5$ ) and available potassium ( $K_2O$ ) were highest with hybrid BH 1576 while among the nitrogen levels,  $300 \text{ kg N ha}^{-1}$  resulted in the highest post harvest soil available nitrogen, available phosphorus ( $P_2O_5$ ) and available potassium ( $K_2O$ ).

The highest gross return, net return and benefit: cost ratio was realized with hybrid BH 40625. Among the nitrogen levels, 200,250,300  $\text{kg N ha}^{-1}$  resulted in the highest gross return, net return and benefit-cost ratio.

In conclusion, the study has revealed that for achieving higher yield of 6-7  $\text{t ha}^{-1}$  with higher B:C ratio, we must select a good hybrid, i.e. BH 40625 coupled with a nitrogen dose of  $200 \text{ kg N ha}^{-1}$  in addition to good package.

## CHAPTER – I

### INTRODUCTION

Maize is one of the important cereal crops of India having diversified uses mainly as food for human beings and feed for animals. Maize is highly productive crop with short duration and photo insensitive thus making it possible to fit in different cropping systems. Major contributing countries to maize production are USA, Brazil, China, India, France and Mexico. In India, maize ranks third in terms of area sown and production next to rice and wheat .Thus there has been an enormous increase in area under cultivation in maize in India occupying an area of 82.60 lakh hectares with the production of 18960 thousand tonnes and the area under maize in Andhra Pradesh is 7.86 lakh hectares with a production of 4135 thousand tonnes (CMIE,2008). In past five years, maize area in A.P increased at a rapid pace as it is suitable for different situations and at present it is replacing the area under tobacco, cotton, and the crop of rice.

Over 85 per cent of maize production in the country is consumed directly as food in various forms such as *chapaties*, roasted ears, pop corn, cornflakes etc. Demand for maize as animal feed, particularly for poultry and starch industry is increasing. Various types of value added products such as animal feed, breakfast food, biscuits, instant *upma*, *kesari bhat*, ready to eat maize puff and instant corn soup mix can be prepared and availability of such value added products encourages increased consumption of maize.

Sankaram (1998) opined that among the nutrients nitrogen is the primary one in the fertilizer management programme for maize as it is the key to realise the yield potential of maize crop. Nitrogen plays a major role both in structural and functional aspects of crop growth. It not only increases yield by increasing total dry matter production but also influences the availability of other essential elements.

The productivity of rabi maize is more compared to kharif maize crop and hence additional plant population with enhanced nitrogen fertilization is required for maximizing the yield potential of presently available genotypes. Maize is a heavy feeder of nutrients. The uptake of nutrients by a maize crop producing 5 t ha<sup>-1</sup> of grain yield was estimated around 105 kg N, 50 kg P<sub>2</sub>O<sub>5</sub> and 75 kg K<sub>2</sub>O kg ha<sup>-1</sup>. Further, it is assumed that for every 100 kg of grain yield 1.8 kg N in the grain and 1.0 kg in the above ground parts of the plant are required and must be supplied by soil and/or fertilizer. At present the information about the response of present single cross hybrids to higher levels of fertilizers particularly nitrogen is meager therefore the present study is proposed to evaluate different maize genotypes in relation to nitrogen fertilization for maximizing grain yields during rabi season.

Keeping these points in view, the present investigation entitled “Evaluation of genotypes for yield maximization in rabi maize (*Zea mays* L.)” was undertaken with the following objectives.

1. To find the best genotypes and optimum nitrogen levels for obtaining maximum yield in *rabi* maize.
2. To study the influence of increased levels of nitrogen on growth and yield of different maize genotypes.
3. To work out economics of the yield maximization and to choose a set of practices for high net returns to farmers.

## **CHAPTER II**

### **REVIEW OF LITERATURE**

Literature pertaining to influence of hybrids and nitrogen levels for yield maximization in *rabi* maize are briefly reviewed in this chapter under appropriate heads .

#### **2.1 PERFORMANCE OF MAIZE HYBRIDS**

##### **2.1.1 GROWTH PARAMETERS**

###### **2.1.1.1 Plant height**

At Chindwara (M.P), J-603 and Ganga safed 2 recorded maximum plant height while Gandan 3 and Kisan recorded the minimum (Yadav *et al.*, 1982). Increased plant height with hybrid DHM 103 as compared to YCF 32 and X 440 was observed by Ashok Kumar (1985). According to Sarveswar Rao (1990) African tall variety recorded higher plant height of 270 cm as compared to DHM 103 (223 cm) and Ganga 5 (222 cm).

Asif Khan *et al.* (2002) observed that among the four cultivars tested, the local cultivar produced the tallest plants (262.78 cm) while pahari produced the shortest plants (213.07 cm). Nagar *et al* (2002) reported that hybrid White maize hybrid recorded higher plant height than Yellow maize hybrid at

harvest. Sanjeev malaiya *et al.*, (2004) reported that hybrid Mahyco -1765 Pro Agro recorded higher plant height (177.45 cm) than Mahyco -1765 (173.97 cm), Nutan -581 (160.61 cm) at harvest. Hassanein *et al.*, (2007) observed that among the three maize hybrids Single Cross 10, Three Way Cross 310 and Three Way Cross 324, Single Cross 10 recorded higher plant height than others.

#### **2.1.1.2 Leaf area and leaf area index**

El-Hattab *et al.* (1985) found that the leaf area index varied consistently at all the growth stages among three maize cultivars tested. Ahmed (1989) revealed that among 4 maize cultivars, Giza-2 and D.C-202 produced significantly greater leaf area index. Sreedhar *et al.* (1993) reported that DHM 103 produced greater leaf area index than EVB-21.

According to Afzal Begum (1994) maize hybrid Trishulatha recorded higher number of functional leaves (7.6) and leaf area index than Pioneer H 3455 and APFM-8. Maize cultivar Y13 produced maximum leaf area index than DH-1 at anthesis (Zeng Hongjian *et al.*, 2001). Hassanein *et al.*, (2007) observed that among the three maize hybrids Single Cross 10, Three Way Cross 310 and Three Way Cross 324, Single Cross 10 recorded higher leaf area index than others.

### 2.1.1.3 Total dry matter production

Taneja *et al.* (1984) recorded maximum dry matter of 96.5 q ha<sup>-1</sup> with maize variety Vijay. Ashok Kumar (1985) reported that the hybrid X 440 produced more dry matter than YCF-32 and DHM 103. Among different genotypes tried, Giza-2 and DC-202 produced greater total dry matter than T.C-141 and pioneer 3147 (Ahmed, 1989). According to Munuswamy *et al.* (1990), Syn-B-21 recorded highest dry matter at harvest as compared to M-13, VC80, Vijay, Ganga-5 and DHM 103.

African tall cultivar was found to be superior in dry matter accumulation than Ganga 5 and DHM 103 (Sarveswar Rao, 1990). Sreedhar *et al.* (1993) reported that DHM 103 produced higher total dry matter (84.04 g plant<sup>-1</sup>) than EVB-21 (77.86 g plant<sup>-1</sup>) at harvest.

Tiwana *et al.*, (1999) studied the performance of three maize varieties and found that variety FML -13 recorded significantly higher dry matter yield ( 7.0 t ha<sup>-1</sup>) as compared to Africa tall (6.6 t ha<sup>-1</sup>) and FML -15 (6.1 t ha<sup>-1</sup>). Sanjeev malaiya *et al.*, (2004) reported that hybrid Mahyco -1765 recorded higher total dry matter (121.32 g plant<sup>-1</sup>) than Pro Agro (104.74 g plant<sup>-1</sup>), Nutan -581 (101.04 g plant<sup>-1</sup>). Khaliq *et al.*, (2009) reported that hybrid Hybrid Bemasal-202 recorded higher total dry matter than hybrid Monsanto-919.

### **2.1.2 Days to 50 per cent Silking**

Remison and Lucas (1982) observed that FARZ 25 produced male and female inflorescence earlier by 9 and 6 days respectively as compared to FARZ 23. Ashok Kumar (1985) stated that DHM 103 took less number of days to 50 per cent silking as compared to YCF-32 and X 440. Sarveswar Rao (1990) opined that Ganga 5 took less number of days to 50 per cent tasseling and silking as compared to DHM 103 and African tall.

Pandey *et al* (2000) reported that hybrid VL 42 took less number of days to 50 per cent silking as compared to variety VL 16. Among four maize cultivars tested, maximum number of days to 50 per cent tasseling were recorded in Azam while minimum number of days were recorded in Pahari (Asif Khan *et al.*, 2002).

### **2.1.3 YIELD COMPONENTS**

#### **2.1.3.1 Cob size (Length and Girth)**

Remison and Lucas (1982) found that FARZ 25 has a greater cob diameter than FARZ 23.

Sreedhar *et al.* (1993) reported that DHM 103 produced significantly longer cobs than EVB 21.

Purushotam kumar *et al.* (2001) reported that Salooni local recorded maximum cob length (16.1 cm) as compared to early composite (13.6 cm) and Parvati (12.5 cm). Nagar *et al* (2002) reported that White maize hybrid recorded maximum cob length than Yellow maize hybrid at harvest.

### **2.1.3.2 Number of rows and grains cob<sup>-1</sup>**

Remison and Lucas (1982) observed that FARZ 25 had more grain rows cob<sup>-1</sup> and more number of grains cob<sup>-1</sup> as compared to FARZ 23.

Ashok Kumar (1985) recorded maximum number of grains cob<sup>-1</sup> with X 440 variety than DHM 103 and YCF 32.

Reddy *et al.* (1987) observed that number of grains cob<sup>-1</sup> were higher with X 440 as compared to DHM 103 and YCF 32.

Sarveswar Rao (1990) reported that Ganga 5 recorded more number of grains cob<sup>-1</sup> as compared to DHM 103 and African tall while according to Sreedhar *et al.* (1993), maize cultivar DHM 103 produced more number of grains cob<sup>-1</sup> than EVB 21.

Anil kumar *et al.*, (2004) observed that number of grains cob<sup>-1</sup> were higher with KH 517 as compared to Early composite , L 118 ,and SLM 2 .

### **2.1.3.3 Weight of grains cob<sup>-1</sup>**

Reddy *et al.* (1987) observed that grain weight cob<sup>-1</sup> was maximum with X 440 as compared to other hybrids *viz.*, DHM 103 and YCF 32.

Sreedhar *et al.* (1993) recorded higher grain weight cob<sup>-1</sup> with DHM 103 as compared to EVB 21.

Khaliq *et al.* (2009) observed that grain weight cob<sup>-1</sup> was maximum with Hybrid Bemasal-202 recorded higher grain weight cob<sup>-1</sup> than hybrid Monsanto-919.

### **2.1.3.4 Shelling percentage**

Halemani *et al.* (1980) reported that hybrid EH 2407 had the highest shelling percentage than other genotypes.

Sreedhar *et al.* (1993) revealed that maize hybrid DHM 103 resulted in higher shelling percentage as compared to EVB 21.

Dilip singh *et al.* (2006) reported that hybrid PHEM 2 resulted in higher shelling percentage as compared to PHEM 1.

### **2.1.3.5 Test weight(gm)**

Ashok Kumar (1985) reported that hybrid X 440 recorded higher test weight over DHM 103 and YCF 32.

The cultivar Ganga 5 recorded higher test weight as compared to DHM 103 (Sarveswar Rao, 1990).

Sreedhar *et al.* (1993) recorded significantly higher test weight with DHM 103 as compared to EVB 21.

Asif Khan *et al.* (2002) reported the highest 1000 grain weight with local cultivar as compared to cultivar Pahari.

Maximum 1000 grain weight (214.9 g) was recorded with Sarhad white cultivar as compared to all other five cultivars (Yousafzai *et al.*, 2002).

Aftab *et al.* (2007) reported that maximum 1000-grain weight (277.02 g) was achieved by P-31-R-88, followed by B-202 (273.18 g) and M-919 (233.68 g)

### **2.1.4 Grain Yield**

Reddy *et al.* (1981) found that the hybrids Deccan 101 and EH 400175 were significantly superior in terms of grain yield to Arbhavi local and composites, Manjri and B-VI.

Ashok Kumar (1985) obtained higher grain yield of 5.3 t ha<sup>-1</sup> with X440 as compared to DHM 103 (46.23) and YCF 32 (4.8 t ha<sup>-1</sup>).

Reddy *et al.* (1987) during their two years of study with four varieties of maize reported that the hybrid X440 recorded significantly higher grain yield over YCF 32, DHM 103 and YCF 39.

Swamy *et al.* (1989) observed that among the seven high yielding maize germplasms evaluated, hybrid DHM 103 recorded significantly higher grain yield (48.3 q ha<sup>-1</sup>) as compared to Vijay composite (38.5 q ha<sup>-1</sup>).

Srinivasa Raju *et al.* (1997) reported that maize cultivar KH 5991 produced higher grain yield (6.3 t ha<sup>-1</sup>) as compared to MMH 72 (6.0 t ha<sup>-1</sup>).

The highest grain yield (4406 kg ha<sup>-1</sup>) was recorded by Vijay variety compared to Diara 3 and Hunius (Prodhan, 2001).

Aftab *et al.* (2007) reported that maize hybrid P-31-R-88 showed higher grain yield (8.33 t ha<sup>-1</sup>) than B-202 (7.77 t ha<sup>-1</sup>) and M-919 (6.16 t ha<sup>-1</sup>).

### **2.1.5 Stover Yield**

Reddy *et al.* (1987) reported that hybrid 440 recorded significantly higher stover yield as compared to YCF 32 and DHM 103.

According to Sarveswar Rao (1990) African tall resulted in significantly higher stover yield over DHM 103 and Ganga 5.

Prodhan (2001) obtained the highest stover yield ( $7640 \text{ kg ha}^{-1}$ ) with Vijay variety as compared to Diara 3 and Hunius.

Bharathi .S(2004) reported that variety Ashwini recorded significantly higher stover yield as compared to Harsha , Varun and Amber popcorn.

### **2.1.6 Harvest Index**

Sreedhar *et al.* (1993) recorded significantly higher harvest index with DHM 103 as compared to EVB 21.

Pandey *et al* (2000) observed that VL 42 resulted in higher harvest index than VL 16.

Purushotam kumar *et al.* (2001) reported that Salooni local recorded higher harvest index as compared to early composite and Parvati..

Anil Kumar *et al.* (2002) observed that hybrid KH 517 recorded significantly higher harvest index as compared to KH 101, PSCL 3436 and Early composite .

Bharathi (2004) reported that variety recorded significantly higher higher harvest index with Harsha as compared to, Ashwini, Varun and Amber popcorn.

### **2.1.7 EFFECT OF VARIETIES ON PROTEIN CONTENT**

Shanti *et al.*, (1997) studied the performance of two maize varieties and found that DHM 107 registered the highest crude protein content followed by Varun .

Tiwana *et al.*, (1999) studied the performance of three maize varieties and found that African tall registered the highest crude protein content of 9.59 percent followed by FML-15 and FML-13.

Manish kumar *et al.*, (2001) reported that ProAgro hybrid 3436 registered significantly higher protein content in grain as compared to Devki and Rajendra hybrid.

### **2.1.8 EFFECT OF VARIETIES ON NUTRIENT UPTAKE**

Anil kumar *et al.*, (2004) studied the performance of four maize varieties viz., early composite , SLM 2 ,L118 ,and KH 517. The results showed that KH 517 recorded highest nitrogen uptake(223.40 kg ha<sup>-1</sup>) followed by L118 (213.02 kg ha<sup>-1</sup>).

## **2.1.9 ECONOMICS**

DHM 103 gave higher benefit cost ratio and economic returns than EVB 21 (Sreedhar *et al.*, 1993) while KH 517 gave higher benefit cost ratio and economic returns than KH 101, PSCL 3436 and Early composite (Anil Kumar *et al.*, 2002).

PHEM 2 gave higher benefit cost ratio and economic returns than PHEM 1 (Dilip singh *et al.*, 2006).

## **2.2 NITROGEN LEVELS**

### **2.2.1 EFFECT OF NITROGEN LEVELS ON GROWTH CHARACTERS**

#### **2.2.1.1 Plant height**

Kumpavat and Rathore (1995) reported that plant height of maize increased significantly with each increment in nitrogen level from 40 to 120 kg N ha<sup>-1</sup>.

Shanti *et al.*, (1997) found a steady increase in plant height with increase in nitrogen level from 0 to 160 kg ha<sup>-1</sup>. Plant height increased with increase in nitrogen level from 0 to 120 kg ha<sup>-1</sup>(Shivay *et al.*, 1999).

Thakur and Vinod Sharma (1999) found that the plant height increased progressively with increasing nitrogen rates upto 200 kg ha<sup>-1</sup>, but the increase was not significant beyond 150 kg ha<sup>-1</sup>.

Amar Singh *et al* (2000) noticed that application of nitrogen upto 120 kg ha<sup>-1</sup> significantly increased the plant height, while Sarma *et al* (2000) found that the plant height increased with increasing nitrogen upto 120 kg ha<sup>-1</sup>, but significant increase was observed upto 90 kg ha<sup>-1</sup> only.

Muhammad *et al* (2000) recorded maximum plant height with 150 kg ha<sup>-1</sup>. Similar increase in plant height with increased N levels upto 90 kg ha<sup>-1</sup> ( Purushottam Kumar and Puri, 2001 ), and 120 kg ha<sup>-1</sup> ( Ayub *et al*, 2001 ) was observed by other workers in maize.

Arya and Singh (2001) found that the plant height increased with increased phosphorus level upto 39.6 kg ha<sup>-1</sup>.

Misra *et al* (2001) reported that the plant height increased upto 150 : 60 : 40 kg ha<sup>-1</sup> N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O.

Arya *et al* (2002) observed that the plant height significantly increased with increasing phosphorus upto 60 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>.

Experiment conducted by Muniswamy *et al.*, (2007) indicated that plant height increased significantly with each increment of nitrogen from 80 to 160 kg ha<sup>-1</sup>.

Suryavanshi *et al.*, (2008) reported that an application of 150 kg nitrogen ha<sup>-1</sup> was found significantly effective over 50 and 100 kg nitrogen ha<sup>-1</sup> in increasing plant height.

#### **2.2.1.2 Number of green leaves per plant**

Rohitashav Singh *et al.*, (1993) revealed that with increase in nitrogen

levels from 0 to 120 kg ha<sup>-1</sup> there was increase in green leaves per plant.

Thakur *et al.*, (1997) reported that number of functional leaves increased with increase in dose of nitrogen from 0 to 200 kg ha<sup>-1</sup>.

Experiment conducted by Muniswamy *et al.*, (2007) indicated that number of green leaves increased significantly with each increment of nitrogen from 80 to 160 kg ha<sup>-1</sup>.

### **2.2.1.3 Leaf area index (LAI)**

LAI increased significantly with increase in nitrogen level from 75 to 175 kg ha<sup>-1</sup> (Selvaraju and Iruthayaraj, 1993), where as LAI increased with increase in nitrogen level from 0 to 240 kg ha<sup>-1</sup> (Sanjeev Kumar and Bangarwa, 1997).

Increased LAI with increasing nitrogen level from 0 to 160 kg ha<sup>-1</sup> was observed by Shanti *et al* (1997).

LAI increased significantly with increase in nitrogen level from 0 to 120 kg ha<sup>-1</sup> (Shivay *et al.*, 1999).

Amar Singh *et al* (2000) recorded Significant increase in LAI was reported with increasing nitrogen levels from 0 to 120 kg ha<sup>-1</sup> (Amar Singh *et al* 2000 and Ammaji and Suryanarayana ,2000)

Misra *et al* (2001) reported that fertilizer applied at the highest level ( 150 : 60 : 40 kg N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O ha<sup>-1</sup> ) resulted in higher leaf area index.

Experiment conducted by Muniswamy *et al.*, (2007) indicated that leaf area

increased significantly with each increment of nitrogen from 80 to 160 kg ha<sup>-1</sup>.

Suryavanshi *et al.*, (2008) reported that an application of 150 kg nitrogen ha<sup>-1</sup> was found significantly effective over 50 and 100 kg nitrogen ha<sup>-1</sup> in increasing leaf area.

#### **2.2.1.4 Dry matter production**

Increase in dry matter gm m<sup>-2</sup> with increase in nitrogen level from 0 to 240 kg ha<sup>-1</sup> was reported by Sanjeev Kumar and Bangarwa, 1997.

Shanti *et al* (1997) reported that with increasing nitrogen levels from 0 to 160 kg ha<sup>-1</sup>, dry matter production increased but significant increase was observed upto 120 kg ha<sup>-1</sup> only.

Increase in dry matter production with increasing nitrogen levels was also reported by several workers *viz.*, 200 kg ha<sup>-1</sup> (Thakur *et al.*, 19970); and 120 kg ha<sup>-1</sup> (Shivay and Singh, 2000).

Similar increase in dry matter production with 120 kg N ha<sup>-1</sup> was also obtained by Amar Singh *et al* (2000), and Ayub *et al* (2001).

Suryavanshi *et al.*, (2008) reported that an application of 150 kg nitrogen ha<sup>-1</sup> was found significantly effective over 50 and 100 kg nitrogen ha<sup>-1</sup> in increasing total dry matter per plant (161.96 to 204.68g).

#### **2.2.1.5 Days to 50% Silking**

Decrease in number of days to silking (from 63 to 58) was observed with

increase in nitrogen levels from 0 to 135 kg ha<sup>-1</sup> (Paradkar and Sharma, 1993).

Shanti *et al.*, (1997) reported advancement of silking by 7.9 and 8.4 days, respectively under 120 and 160 kg N ha<sup>-1</sup> in comparison to the crop with no nitrogen treatment.

Arya and Singh (2001) reported that application of phosphorus @ 39.6 kg ha<sup>-1</sup> significantly reduced the days to 50 percent silking.

Earlier appearance to silking was observed with increase in nitrogen levels from 80 to 160 kg ha<sup>-1</sup> (Muniswamy *et al.*, 2007).

## **2.2.2 EFFECT OF NITROGEN LEVELS ON YIELD ATTRIBUTES**

### **2.2.2.1 Number of cobs per plant**

Increase in number of cobs per plant (1.48 to 2.49) was observed with increase in nitrogen level from 0 to 200 kg ha<sup>-1</sup> (Thakur *et al.*, 1997).

Increasing level of nitrogen from 0 to 225 kg ha<sup>-1</sup> significantly increased number of cobs per plant (Tyagi *et al.*, 1998).

Sahoo and Mahapatra (2004) observed significant increase in number of cobs per plant with each increment of nitrogen from 60 to 180 kg ha<sup>-1</sup>.

Increasing level of nitrogen from 80 to 160 kg ha<sup>-1</sup> significantly increased the number of cobs per plant (Muniswamy *et al.*, 2007).

### 2.2.2.2 Cob length

Paradkar and Sharma (1993) indicated that cob length increased significantly with each increment of nitrogen from 80 to 240 kg ha<sup>-1</sup> and cob length was linearly increased with increased dose of nitrogen from 0 to 135 kg ha<sup>-1</sup>.

Increasing levels of nitrogen from 75 to 175 kg ha<sup>-1</sup> significantly increased the cob length in maize (Selvaraju and Iruthayaraj, 1994).

Kuruvila Varughese and Iruthayaraj (1996) found that increase in nitrogen level from 62.5 to 250 kg ha<sup>-1</sup> increased the cob length.

Tyagi *et al.*, (1998) observed significant increase in cob length with each increment of nitrogen from 0 to 225 kg ha<sup>-1</sup>.

Thakur and Vinod Sharma (1999) found that the length of the cob increased progressively with successive increase in N application upto 200 kg ha<sup>-1</sup>.

Pandey *et al* (2000) and Purushottam Kumar and Puri (2001) reported that the length of the cob increased progressively with increasing nitrogen levels.

Sahoo and Mahapatra (2004) observed significant increase in cob length with each increment of nitrogen from 60 to 180 kg ha<sup>-1</sup>.

Kar *et al.*, (2006) indicated that length of green cobs increased significantly with each increment of nitrogen from 0 to 80 kg ha<sup>-1</sup>.

Increasing level of nitrogen from 80 to 160 kg ha<sup>-1</sup> significantly increases the cob length (Muniswamy *et al.*, 2007).

Suryavanshi *et al.*, (2008) reported that an application of 150 kg nitrogen ha<sup>-1</sup> was found significantly effective over 50 and 100 kg nitrogen ha<sup>-1</sup> in increasing cob length.

### **2.2.2.3 Cob girth**

Application of nitrogen (75 to 175 kg ha<sup>-1</sup>) linearly increased the girth of cob (Selvaraju and Iruthayaraj, 1994).

Experiment conducted by Kuruvila Varughese and Iruthayaraj (1996) revealed that with increase in nitrogen level there was increase in cob girth.

Cob diameter increased significantly when nitrogen level increased from 0 to 120 kg ha<sup>-1</sup> (Mahajan *et al.*, 1997).

According to Srinivasa Raju *et al* (1997), girth of the cob increased up to 135 kg nitrogen ha<sup>-1</sup> only beyond which there was no significant response. On the other hand, Pandey *et al* (2000) and Raja (2001) observed that the cob girth increased significantly with increased nitrogen levels.

Kar *et al.*, (2006) indicated that girth of green cobs increased significantly with each increment of nitrogen from 0 to 80 kg ha<sup>-1</sup>.

Increasing level of nitrogen from 80 to 160 kg ha<sup>-1</sup> significantly increases the cob girth (Muniswamy *et al.*, 2007).

### **2.2.2.4 Test weight**

1000-grain weight increased significantly (270 to 291 g) with increase in level of nitrogen from 0 to 160 kg ha<sup>-1</sup> (Venugopal and Shiva Shankar, 1991).

Increasing level of nitrogen from 0 to 90 kg ha<sup>-1</sup> increased 1000-grain weight of pop corn (Thakur and Malhotra, 1991).

Selvaraju and Iruthayaraj (1994) observed significant increase in 1000-grain weight with each increment of nitrogen from 75 to 175 kg ha<sup>-1</sup>.

Increasing levels of nitrogen from 100 to 200 kg ha<sup>-1</sup> significantly increased 1000-grain weight (Misra *et al.*, 1994).

Kumpavat and Rathore (1995) reported that increase in the level of nitrogen from 40 to 120 kg ha<sup>-1</sup> significantly increased 1000-grain weight.

Srinivasa Raju *et al* (1997) found that the test weight significantly responded to nitrogen application upto 135 kg ha<sup>-1</sup>, beyond which the response was not significant.

1000-grain weight increased significantly (154.6 to 199.4 g) when nitrogen level increased from 0 to 225 kg ha<sup>-1</sup> (Tyagi *et al.*, 1998).

Amar Singh *et al* (2000) and Sharma *et al* (2000) reported that the application of nitrogen up to 120 kg ha<sup>-1</sup> significantly increased the test weight.

Rameswar Singh and Totawat (2002) obtained significant and linear increase in test weight with increasing nitrogen levels

Increasing level of nitrogen from 80 to 160 kg ha<sup>-1</sup> significantly increased the 1000-grain weight (Muniswamy *et al.*, 2007).

Suryavanshi *et al.*, (2008) reported that an application of 150 kg nitrogen ha<sup>-1</sup> was found significantly effective over 50 and 100 kg nitrogen ha<sup>-1</sup> in

increasing 1000-grain weight.

#### **2.2.2.5 Number of grains per cob**

Khot *et al* (1993) observed that the number of grains per cob increased significantly upto 160 kg N ha<sup>-1</sup>, while according to Kaul *et al* (1994), the number of grains per cob increased significantly upto 175 kg N ha<sup>-1</sup> only and further increase upto 225 kg N ha<sup>-1</sup> was not beneficial.

Singh *et al* (1996) reported that the number of grains per cob increased with increase in nitrogen levels from 0 to 90 kg ha<sup>-1</sup>.

Purushottam Kumar and Puri (2001) found that increasing the nitrogen level, increased the number of grains per cob significantly.

Rameswar Singh and Totawat (2002) also reported significant and linear increase in number of grains per cob with increasing nitrogen levels.

Increasing level of nitrogen from 80 to 160 kg ha<sup>-1</sup> significantly increases number of grains per cob (Muniswamy *et al.*, 2007).

#### **2.2.2.6 Weight of grains per cob**

Sridhar *et al* (1991) found that the grain weight per cob increased significantly with increased nutrient levels upto 180 : 90 : 60 kg ha<sup>-1</sup> of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O compared to control.

Thakur and Malhotra (1991) observed that the grain weight per cob increased with increase in nitrogen dose upto 60 kg ha<sup>-1</sup> but further increase in nitrogen level did not have any significant influence.

According to Shanti *et al* (1997), weight of the grains per cob increased with increasing nitrogen level from 0 to 160 kg ha<sup>-1</sup>, but significant increase was observed upto 120 kg ha<sup>-1</sup> only.

Amar Singh *et al* (2000) reported that application of nitrogen upto 120 kg ha<sup>-1</sup> significantly increased the grain weight per cob.

Increasing level of nitrogen from 80 to 160 kg ha<sup>-1</sup> significantly increased the grain weight per cob. (Muniswamy *et al.*, 2002)

### **2.2.3 EFFECT OF NITROGEN LEVELS ON GRAIN AND STOVER**

#### **YIELD**

##### **2.2.3.1 Grain yield of Maize**

Paradkar and Sharma (1993) observed significant increase in grain yield with each increment of nitrogen from 0 to 135 kg ha<sup>-1</sup>.

Sreedhar *et al.*, (1993) found that application of nitrogen at 150 kg ha<sup>-1</sup> gave significantly higher grain yield (1464 kg ha<sup>-1</sup>) in comparison to no nitrogen (412 kg ha<sup>-1</sup>).

Nitrogen application significantly and steadily increased the grain yield. Maximum yield was obtained under 240 kg N ha<sup>-1</sup> that was significantly superior to that of 80 kg N ha<sup>-1</sup> but at par with that of 160 kg N ha<sup>-1</sup> (Paradkar and Sharma, 1993).

Selvaraju and Iruthayaraj (1994) reported significant increase in grain yield

with increment of nitrogen from 75 to 175 kg ha<sup>-1</sup>.

The grain yield of maize markedly increased with nitrogen application up to 175 kg ha<sup>-1</sup> (Kaul *et al.*, 1994).

Thakur *et al.*, (1995) reported that the magnitude of increase in cob yield was 39.21, 27.49, 18.94 and 4.76 percent by increasing the N levels to 50, 100, 150 and 200 kg ha<sup>-1</sup> respectively.

The grain yields of maize increased significantly with increase in the level of N. Application of 120 kg N ha<sup>-1</sup> gave significantly higher grain yield over 40 and 80 kg N ha<sup>-1</sup> (Kumpavat and Rathore, 1995).

Grain yield increased linearly with increase in nitrogen level from 93.75 to 156.25 kg ha<sup>-1</sup> (Kuruvila Varughese and Iruthayaraj, 1996) .

Shivay *et al.*, (1999) revealed that application of 120 kg ha<sup>-1</sup> resulted in significantly higher grain yield over lower levels of nitrogen.

Thakur and Vinod Sharma (1999) found that the grain yield increased progressively with increase in the rates of nitrogen application upto 200 kg ha<sup>-1</sup> but the increase was not significant beyond 150 kg N ha<sup>-1</sup>.

Significant increase in grain yield was observed when nitrogen level increased from 60 to 150 kg ha<sup>-1</sup>. But further increase in nitrogen to 180 kg ha<sup>-1</sup> decreased the grain yield (Ameta and Dhakar, 2000).

Parmar and Vinod Sharma (2001) observed that the grain yield increased upto 90 kg N ha<sup>-1</sup> only, beyond which, there was no significant response. On the

other hand, progressive and consistent increase in grain yield of maize with increased levels of nitrogen was reported by Purushottam Kumar and Puri (2001); Rameswar Singh and Totawat (2002); and Kuo *et al.* (2002).

Muhammad Rasheed *et al.* (2003) observed that the application of 250 : 150 : 100 kg ha<sup>-1</sup> N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O produced significantly higher grain yield.

Kar *et al.*, (2006) reported that application of 80 kg nitrogen ha<sup>-1</sup> resulted highest green-cob yield which was 220, 160, 48 and 21 percent higher than that of the control and 20, 40, and 60 kg nitrogen ha<sup>-1</sup>.

Significant linear increase in grain yield (18.23 to 23.90 q ha<sup>-1</sup>) observed with increase in nitrogen levels from 80 to 160 kg ha<sup>-1</sup> (Muniswamy *et al.*, 2007).

Increasing levels of nitrogen from 50 to 150 kg ha<sup>-1</sup> resulted in significant increase in grain yield of maize (Suryavanshi *et al.*, 2008).

### **2.2.3.2 Stover yield**

Nageswara Reddy *et al.*, (1994) have reported maximum stover yield with an application of 180 kg ha<sup>-1</sup>, whereas the highest stover yield was obtained with 120 kg N ha<sup>-1</sup> (Rajput *et al.*, 1994) and 175 kg N ha<sup>-1</sup> (Kaul *et al.*, 1994).

Thakur *et al.*, (1995) observed significant increase in green fodder yield up to 200 kg N ha<sup>-1</sup> in baby corn. Linear response of stover yield with an increase in N levels were observed by ( Varughese and Iruthayaraj, 1996).

Dey and Sharma (1996) obtained significantly higher stover yield with graded fertilization of 40 N, 8.8 P and 16.8 K kg ha<sup>-1</sup>, which was attributed to

increased efficiency of N as well as higher N uptake.

Shanti *et al* (1997) found that with increasing nitrogen level upto 160 kg ha<sup>-1</sup>, stover yield of maize increased significantly.

Srinivasa Raju *et al* (1997) reported increased stover yield of maize due to increased nitrogen levels.

Thakur and Sharma (1999) recorded significantly higher fodder yield with 200 kg N ha<sup>-1</sup>, but the difference between 100 and 150 kg was not significant.

Singh *et al* (2000) revealed that the stover yield increased significantly with each successive increment in nitrogen upto 150 kg ha<sup>-1</sup>, beyond which the increase was marginal.

Muhammad Ayub *et al* (2000) found that the fodder yield of maize increased significantly with increased nitrogen rates from 0 to 150 kg ha<sup>-1</sup>.

Significant increase in stover yield was observed when nitrogen level increased from 60 to 150kg ha<sup>-1</sup>. But further increase in nitrogen 180 kg ha<sup>-1</sup> decreased the stover yield (Ameta and Dhakar, 2000).

Arya and Singh (2001) reported that phosphorus application @ 39.6 kg ha<sup>-1</sup> gave significantly higher stover yield compared to other levels during two years of experimentation.

Rameswar Singh and Totawat (2002) reported that with increased nitrogen level, the stover yield of maize increased significantly.

Muhammad Rasheed *et al.* (2003) observed that the application of 250 : 150 : 100 kg ha<sup>-1</sup> N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O produced significantly higher stover yield than control.

Increasing level of nitrogen from 0 to 80 kg ha<sup>-1</sup> significantly increased the green forage yield from 6.68 to 17.35 t ha<sup>-1</sup> ( Kar *et al.*, 2006).

Increasing levels of nitrogen from 50 to 150 kg ha<sup>-1</sup> resulted significant increase in stover yield of maize (43.97 to 62.07 q ha<sup>-1</sup>) (Suryavanshi *et al.*, 2008).

#### **2.2.4 EFFECT OF NITROGEN LEVELS ON PROTEIN CONTENT OF GRAIN**

Increase in levels of nitrogen from 0 to 120 kg ha<sup>-1</sup> increased the protein content (Rohitashav *et al.*, 1993).

Shanti *et al* (1994) observed that the protein content of maize grains increased significantly with increased nitrogen level upto 120 kg ha<sup>-1</sup>, but further increase upto 160 kg ha<sup>-1</sup> did not prove to be advantageous.

Misra *et al.*, (1994) observed increase in protein content in grain with increase in nitrogen level from 100 to 200 kg ha<sup>-1</sup>.

Lower levels of nitrogen resulted in lower content of protein (Kamala Kumari and Singaram, 1996).

Krishna *et al.*, (1998) reported that increasing levels of nitrogen from 0 to 180 kg ha<sup>-1</sup> increased the protein content significantly.

Protein content of maize significantly increased with each and every increase in nitrogen level ( Ghosh and Singh, 1995 ).

Ayub *et al* (2001) opined that each level of nitrogen application significantly influenced the protein content and 80 and 120 kg ha<sup>-1</sup> had significantly higher crude protein content compared to control.

Raja (2001) obtained increased and higher protein content of with each higher level of nitrogen.

Misra *et al* (2001) found that the protein and carbohydrate contents increased significantly with increase in fertilizer level of 150 : 60 : 40 kg NPK ha<sup>-1</sup>.

Duraisami *et al* (2002) reported that the crude protein content increased with increased nitrogen dose, but the carbohydrate and sugar contents were increased only upto 60 kg N ha<sup>-1</sup>, beyond which it was not found to be advantageous.

Kar *et al.*, (2006) revealed that protein yield increased significantly with increase in nitrogen from 0 to 80 kg ha<sup>-1</sup>.

Increasing protein content of maize grain was observed significant upto 100 kg nitrogen ha<sup>-1</sup> over 50 and 150 kg nitrogen ha<sup>-1</sup> (Suryavanshi *et al.*, 2008).

#### **2.2.5 EFFECT OF NITROGEN LEVELS ON N-UPTAKE**

Bhaskaran *et al.*, (1992) experiment conducted with five nitrogen levels (0 to 202.5 kg ha<sup>-1</sup>) revealed that the N-uptake showed a positive trend with nitrogen

application at all stages of crop growth. Application of 202.5 kg N ha<sup>-1</sup> recorded the highest N-uptake by shoot and grain.

N-uptake by grain and stover increased significantly with increase in N-level from 80 to 120 kg ha<sup>-1</sup> (Gaur *et al.*, 1992).

Increasing level of nitrogen from 75 kg to 175 kg ha<sup>-1</sup> significantly increased the N-uptake (Selvaraju and Iruthayaraj, 1995).

Shivay *et al.*, (1999) found that increase in nitrogen level from 0 to 120 kg ha<sup>-1</sup> significantly increased the N-uptake by grain as well as stover.

N-uptake by green kernels and stover increased significantly with increase in nitrogen from 0 to 80 kg ha<sup>-1</sup> (Kar *et al.*, 2006).

## **2.2.6 ECONOMICS**

Thakur and Vinod Sharma (1999) revealed that the application of nitrogen @ 150 and 200 kg ha<sup>-1</sup> gave 29.2 and 37.6 per cent higher net returns over 100 kg N ha<sup>-1</sup>, respectively and the net return per rupee invested increased with increased rates of nitrogen application. However, this increase was maximum ( 32.11% ) with 200 kg ha<sup>-1</sup> of nitrogen.

Amar Singh *et al* (2000) revealed that with increased nitrogen levels from 0 to 120 kg ha<sup>-1</sup>, the net returns increased from Rs.10503/- to Rs.20080/- ha<sup>-1</sup>.

Pandey *et al* (2000) found that application of 120 kg N ha<sup>-1</sup> resulted in significantly higher net returns of 27.3 and 8.6 per cent over 60 and 90 kg N ha<sup>-1</sup>, respectively and the benefit : cost ratio was also the highest with 120 kg N ha<sup>-1</sup>.

Sharma *et al* (2000) obtained higher values of net return and benefit : cost ratio, with an increase in nitrogen dose from 30 to 120 kg ha<sup>-1</sup>, but 90 kg ha<sup>-1</sup> was considered to be an economic dose for maize.

Significant increase in net monetary returns (Rs. 11,231 ha<sup>-1</sup>) was recorded from 60 to 150 kg N ha<sup>-1</sup> (Ameta and Dhakar, 2000).

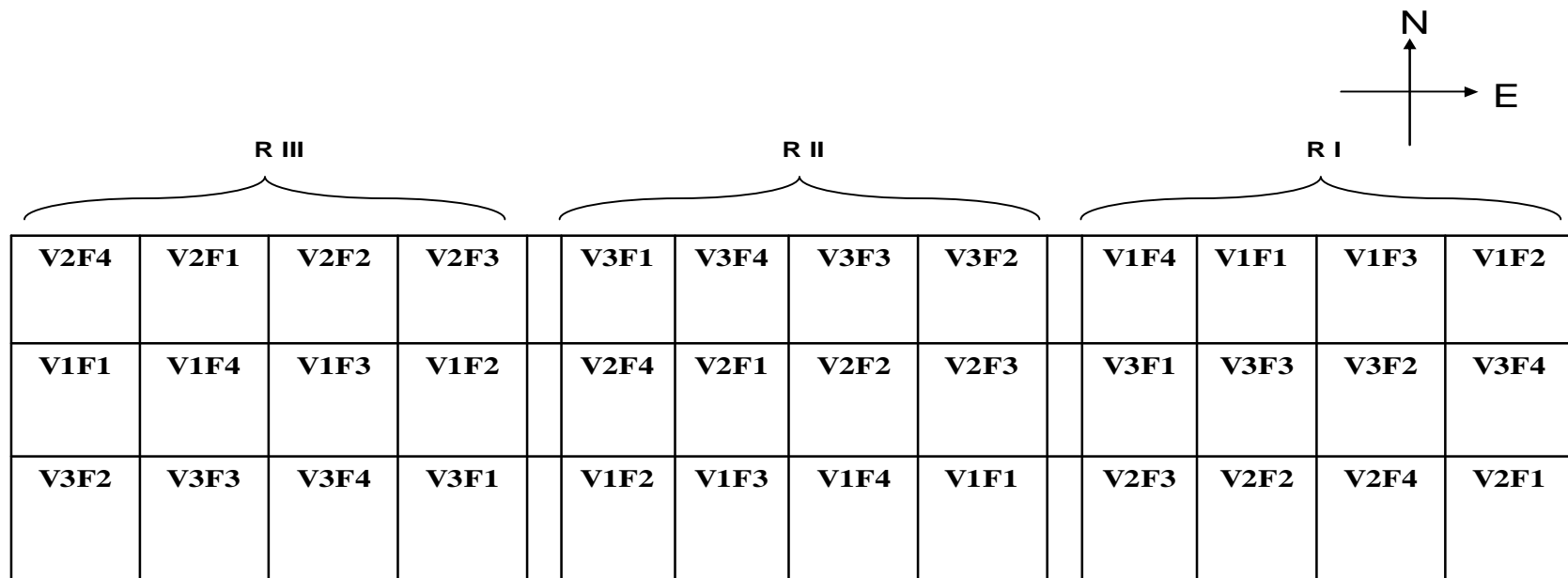
Kar *et al.*, (2006) while working with sweet corn reported that application of nitrogen 0 to 80 kg ha<sup>-1</sup> gave significantly higher net returns and benefit: cost ratio.

Sahoo and Mahapatra (2004) observed significant increase in net profit with each increment of nitrogen from 60 to 180 kg ha<sup>-1</sup>.

Suryavanshi *et al.*, (2008) obtained significantly higher gross returns, net monetary returns and benefit: cost ratio from 150 kg nitrogen ha<sup>-1</sup> over 50 and 100 kg nitrogen ha<sup>-1</sup>.







Season : Rabi 2008-09  
 Layout of experiment : Split plot Design  
 Replications : 3  
 Treatments : Twelve  
 Spacing : 60 cm X 25cm  
 Plot size : 6m X 3.75m  
 Net plot size : 3.6 m X 2.75

**TREATMENTS:**  
**Main plots : 3 Genotypes**  
 V1 : BH-40625  
 V2 : BH-1576  
 V3 : Super 900M  
**Sub plots : 4 Nitrogen levels**  
 F1 – 150 kg N / ha  
 F2 - 200 kg N / ha  
 F3 - 250 kg N / ha  
 F4 - 300 kg N / ha

**Fig.2: Field lay out plan**

## **CHAPTER III**

### **MATERIAL AND METHODS**

The experiment entitled “Evaluation of genotypes and Nitrogen levels for yield maximization in *rabi* maize (*Zea mays* L.)” was conducted during *rabi* , 2008-2009. The materials used and methods adopted in the present investigation are explained in this chapter.

#### **3.1 LOCATION OF THE EXPERIMENTAL SITE**

The present investigation was carried out at the College Farm, College of Agriculture, Rajendranagar, Hyderabad during *rabi* 2008-2009. The Farm is geographically situated at an altitude of 542.3 m above mean sea level at 17° 19' N latitude and 78° 28' E longitude and falls under the Southern Telangana agro climatic zone of Andhra Pradesh.

#### **3.2 WEATHER DURING CROP GROWTH PERIOD**

The weekly mean meteorological data recorded during the crop growth period (27.11.08 to 09.04.09) at meteorological observatory, Agricultural Research Institute, Rajendranagar, Hyderabad are presented in Appendix 1 and illustrated in Fig.1.

The weekly mean maximum temperature during the crop growth period ranged from 23.0°C to 39.5°C with an average of 32.3°C while the weekly mean minimum temperature ranged from 10.8°C to 26.0°C with an average of 17.35°C.

The mean relative humidity ranged from 37 to 76.16 per cent. Normal rain fall of 23 mm was received thrice during the crop growth period. The weekly mean sunshine hours varied from 1.6 to 10.7 with an average of 7.5 hours per day and mean evaporation ranged from 3.1 to 7.8 mm with an average of 5.9 mm per day. The mean wind speed ranged from 1.3 to 8.0 km hr<sup>-1</sup> with an average of 3.71 km hr<sup>-1</sup>. At all stages of the crop growth the weather was congenial for growth and development of maize crop.

### 3.3 SOIL CHARACTERISTICS OF THE EXPERIMENTAL SITE

Before commencement of the field experiment random soil samples were collected from 0 to 30 cm depth, shade dried and passed through 2 mm sieve to make a composite sample which was later analyzed for its physico-chemical properties by following standard procedures.

**Table 1: Soil physico- chemical properties of the experimental site**

Particulars	Value	Method of analysis
<b>Physical analysis</b>		
Sand (%)	60.3	Bouyoucos Hydrometer method (Piper,1966)
Silt (%)	21.3	
Clay (%)	18.4	
Textural class	Sandy loam	
Soil reaction (pH)	7.0	Glass Electrode pH meter (Jackson, 1973)
Electrical conductivity (dS m <sup>-1</sup> )	0.69	Conductivity bridge method (Jackson, 1973)
Organic carbon (%)	0.49	Walkely and Black method (Jackson, 1973)

Available nitrogen (kg ha <sup>-1</sup> )	222.75	Alkaline permanganate method (Subbaiah and Asija, 1956)
Available phosphorus (kg ha <sup>-1</sup> )	22.6	Olsen method (Olsen <i>et al.</i> 1954)
Available potassium (kg ha <sup>-1</sup> )	260.7	Flame photometer method (Jackson, 1973)

Based on soil analysis, the soil of the experimental site was classified as sandy loam, neutral (pH 7.0) with low organic carbon, medium in available nitrogen, phosphorus, and potassium.

### 3.4 CROPPING HISTORY OF EXPERIMENTAL PLOT

The cropping history of the experimental site during the preceding three years is given below:

Year	<i>Kharif</i>	<i>Rabi</i>
2005-2006	Maize	Sunflower
2006-2007	Maize	Sunflower
2007-2008	Maize	Sunflower

#### 3.5.1 Design and layout

The experiment was laid out in split plot design and replicated thrice with twelve treatments and the layout of which is illustrated in Fig. 2

#### 3.5.2 Treatments

The details of the treatments are furnished below

**Main plots : 3 Genotypes**

V<sub>1</sub> : BH-1576

V<sub>2</sub> : Super 900M

V<sub>3</sub> : BH 40625

**Sub plots : 4 Nitrogen levels**

F1 - 150 kg N ha<sup>-1</sup>

F2 - 200 kg N ha<sup>-1</sup>

F3 - 250 kg N ha<sup>-1</sup>

F4 - 300 kg N ha<sup>-1</sup>

**3.5.3 Plot size**

Gross : 6.0 m x 3.75 m

Net : 3.6 m x 2.75 m

**3.5.4 Spacing** : 60 cm x 25 cm.

**3.6 DETAILS OF CULTURAL OPERATIONS**

**3.6.1 Preparatory tillage**

The experimental field was prepared thoroughly by working with tractor mounted disc plough followed by tractor drawn cultivator twice and finally harrowing to achieve optimum tilth subsequently, levelling was done and plots were laidout as per the plan.

**3.6.2 Seeds and sowing**

As per the recommendation, a seed rate of 20 kg ha<sup>-1</sup> was adopted in the study. In conventionally tilled soil, seeds were sown on thoroughly prepared land at a spacing of 60 cm x 25 cm followed by a light irrigation to ensure proper and uniform germination.

### **3.6.3 Gap filling and Thinning**

Gap filling was done one week after sowing to maintain the desired plant population and thinning was carried out one week after gap filling so as to have single plant hill<sup>-1</sup>.

### **3.6.4 Fertilizer application**

Entire quantity of P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O (60:60 kg, P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O ha<sup>-1</sup>) was applied as a basal dose. Nitrogen was applied as per the sub plot treatments in three splits i.e. one third as basal, one third at knee high stage and the remaining one third at tasselling stage. The sources of N, P and K are urea, single super phosphate and muriate of potash respectively. The fertilizers were applied by placement along the lines 5 cm away and 5 cm below the seed rows.

### **3.6.5 Weeding**

Atrazine @ 1.0 kg a.i. ha<sup>-1</sup> was applied as pre-emergence spray after sowing and irrigation. One inter culture and hand weeding were taken at 30 DAE.

### **3.6.6 Irrigation**

All the plots were uniformly irrigated as and when required based on soil moisture content and phenological stages of the crop growth. Total 15 irrigations were given to crop.

### **3.6.7 Plant protection**

Endosulfan @ 2 ml L<sup>-1</sup> of water was sprayed once to control pink stem borer at 25 DAE.

### **3.6.8 Harvesting**

Harvesting was done, when the sheath of the cob dried completely. The cobs of border rows of each plot were harvested and separated first and later the cobs from the net plot were harvested.

### **3.6.9 Threshing**

The cobs were sun dried, shelled with a mechanical hand sheller and the grain was separated. Later grains were sun dried to a moisture content of 14 per cent, cleaned and weighed separately for each plot. The stover yield was recorded after sun drying the plant to a constant weight.

## **3.7 EXPERIMENTAL OBSERVATIONS ON CROP**

Five plants were earmarked at random in the net plot in each treatment to record periodical observations on growth characters, yield attributes and yield of the crop.

### **3.7.1 Pre-harvest observations**

#### **3.7.1.1 Plant population**

The initial plant population after emergence and final plant population at crop maturity were recorded from each experimental plot and expressed in thousand per hectare.

#### **3.7.1.2 Plant height (cm)**

Plant height was recorded at 30, 60, 90 DAS and at harvest from the base of the plant to the ligule of the last leaf before tasseling and upto the tip of the tassel after tassel emergence. The observations were made on the earmarked plants mean computed and expressed in cm.

#### **3.7.1.3 Number of green leaves**

Number of green leaves were recorded at 30, 60 DAS and at harvest. The observations were made on the earmarked plants.

#### **3.7.1.4 Leaf Area Index (LAI)**

By computing the leaf area as explained above, LAI was calculated by using the following formula as suggested by Watson (1952)

$$\text{LAI} = \frac{\text{Leaf area (cm}^2\text{)}}{\text{Land area (cm}^2\text{)}}$$

#### **3.7.1.5 Dry matter production (kg ha<sup>-1</sup>)**

Five plants were uprooted from the destructive sampling area at 30, 60, 90 DAS and at harvest and were sun dried initially and subsequently dried in hot air oven at 60<sup>0</sup>C till constant weight was obtained. Their weights were recorded mean computed and expressed as kg ha<sup>-1</sup>.

#### **3.7.1.6 Days to 50 % tasseling**

The number of days taken by 50 per cent of the plants for in net plot in each treatment from date of emergence to the tasseling was considered as days to 50 per cent tasseling.

#### **3.7.1.7 Number of green leaves**

Number of green leaves were recorded at 30, 60 DAS and at harvest. The observations were made on the earmarked plants.

#### **3.7.1.8 Days to physiological maturity**

Number of days taken by 50 per cent of plants in each treatment from emergence to a stage of black layer formation at base of grain was considered as days to physiological maturity. It was 10-15 days prior to normal harvest.

### **3.7.2 Post-harvest observations**

#### **3.7.2.1 Number of cobs per plant**

Total number of cobs from the earmarked five plants were counted at maturity and expressed as average number of cobs per plant.

#### **3.7.2.2 Length of the ear (cm)**

The length of ear from selected five plants was measured from base to tip of the ear and the mean was computed as ear length in centimeters.

#### **3.7.2.3 Girth of the ear(cm)**

The girth of ears from selected five plants was measured at centre, top and base of ear and the mean was expressed as ear girth in centimeters.

#### **3.7.2.4 Number of grain rows per ear**

Total numbers of grain rows from ears of earmarked plants were counted at maturity and mean was expressed as average number of grain rows per ear.

#### **3.7.2.5 Number of grain per ear**

Total numbers of grain from ears of earmarked plants were counted at maturity and mean was expressed as average number of grain rows per ear.

#### **3.7.2.6 100 seed weight (g)**

A sample of hundred grains was taken from total grain lots of each treatment, weighed and recorded as test weight in grams.

#### **3.7.2.7 Grain yield (kg ha<sup>-1</sup>)**

The matured cobs of each plot were sun dried to a constant weight (14 % moisture) and were later shelled to record the grain weight. Grain weight recorded was expressed in kg ha<sup>-1</sup>.

### 3.7.2.8 Stover yield (kg ha<sup>-1</sup>)

After the harvest of cobs, the left over plants were cut and dried under sun to a constant weight. The Stover yield of the net plot was recorded for individual treatments and expressed in kg ha<sup>-1</sup>.

### 3.7.2.9 GRAIN QUALITY PARAMETERS

The important grain quality parameters of maize were analysed in the laboratory as per the methods detailed below :

Sl.No.	Particulars	Method of analysis
1.	Protein content	AOAC, 1965

## 3.8 PLANT ANALYSIS

For estimating nitrogen, phosphorus and potassium content, well dried plant samples collected for dry matter production were used. Samples from each plot were oven dried, powdered and used for chemical analysis.

### 3.11.1 Nitrogen Uptake (kg ha<sup>-1</sup>)

Nitrogen content in dry matter was estimated by microkjeldahl method (AOAC, 1960). The nitrogen uptake was calculated by multiplying the content of nitrogen with respective dry matter production and expressed in kg ha<sup>-1</sup>

### 3.11.2 Phosphorus Uptake (kg ha<sup>-1</sup>)

The tri-acid digested plant samples were analysed for phosphorus content by Vanado – molybdo phosphoric acid yellow colour method (Jackson, 1967). The intensity

of yellow colour developed was measured using Spectronic – 20 D. The uptake of phosphorus was calculated by multiplying the phosphorus content with the respective drymatter production and expressed in kg ha<sup>-1</sup>.

### 3.11.3 Potassium Uptake (kg ha<sup>-1</sup>)

Potassium content of the extract of tri-acid digested plant material was determined using ELICO flame photometer and uptake of potassium was estimated by multiplying the potassium content with the respective drymatter production and presented in kg ha<sup>-1</sup>.

### 3.7.3.0 Harvest index

Harvest index was computed by adopting the following formula

$$\text{Harvest index} = \frac{\text{Economic yield (grain yield in kg ha}^{-1}\text{)}}{\text{Total biological yield (grain + stover yield in kg ha}^{-1}\text{ + shank and chaff)}} \times 100$$

## 3.8 ECONOMICS

The cost of cultivation for each treatment was computed. Similarly gross returns were calculated based on current market price of the produce. The net returns were obtained after deducting the cost of cultivation from gross returns. Benefit-cost ratio was computed using the following formula:

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

## 3.9 STATISTICAL ANALYSIS

The data so collected for all the characters listed above, was subjected to statistical scrutiny by the method of analysis of variance outlined by Panse and Sukhatme (1985). Statistical significance was tested by 'F' value and wherever the 'F' value was found significant, critical difference was worked out at 5 percent level of probability and the values were furnished. Treatmental differences that were not significant were denoted as NS.

### **3.10 CHEMICAL ANALYSIS**

#### **3.10.1 Soil**

Soil samples were drawn from 0-15 cm depth in treatmental plots before and after harvest of the maize crop and analyzed for available nitrogen (alkaline permanganate method, Subbaiah and Asija, 1956), available phosphorus (Olsen's method, Jackson, 1973), available potassium (N N NH<sub>4</sub>, OAC, Jackson, 1973).

#### **3.10.2 Plant**

Plant samples were drawn from the second border rows of the treatmental plots.

Nitrogen content in maize plant samples was estimated by modified microkjeldhal method (Piper, 1966).

Phosphorus and potassium content were determined in the extracts after digesting the plant material with tri acid mixture of 9: 4: 1 (HNO<sub>3</sub>: H<sub>2</sub>SO<sub>4</sub>: HClO<sub>3</sub>) (Piper, 1966)

The nitrogen, phosphorus and potassium content were expressed as percentage.

The uptake of N, P and K by maize crop was computed on the basis of dry matter accumulation and expressed as  $\text{kg ha}^{-1}$ .

## **CHAPTER – IV**

### **RESULTS**

The results of the present investigation entitled “Evaluation of genotypes and nitrogen levels for yield maximization in *rabi* maize” conducted during *rabi* season of 2008-09 at College Farm, Rajendranagar, Hyderabad are presented here. Experimental data are apportioned under various heads and sub heads and are furnished in tables and illustrated through figures wherever necessary.

#### **4.1 INITIAL AND FINAL PLANT STAND**

Observations of the data on initial and final plant stand of maize (Table 2) indicated that the maize hybrids, nitrogen levels and their interaction effects were not significant. The initial plant stand ranged between 65400- 66000 plants per hectare and the final plant stand ranged from 64200-65300 plants per hectare since the conditions were favorable to crop growth and pest and disease problem were at minimum level, population stand till maturity was maintained.

#### **4.2. PLANT HEIGHT**

Plant height was recorded at different growth stages and the analyzed data is presented in the table 2

Study of the data indicated that plant height significantly influenced by nitrogen levels only at all the stages of growth. The hybrids behaved equally at 30

and 60 DAS, but at harvest they varied significantly. Comparatively the hybrid BH 40625 was superior to other two hybrids. The plant height increased significantly with the increasing nitrogen levels from 150 to 300 kg ha<sup>-1</sup> at the three stages. Maximum plant height of 216.9 cm was recorded by 30 kg N ha<sup>-1</sup> which was more by 24, 16.7 and 8.2 cm over 150, 200, and 250 kg ha<sup>-1</sup> respectively.

The interaction between hybrids and nitrogen levels did not reach the level of significance at any stage of the crop.

### **4.3 Number of green leaves per plant**

The data on number of green leaves per plant recorded at different crop growth stages are presented in table 4. Green leaf number increased sharply up to 60 DAS and thereafter declined gradually towards harvest.

There was no significant difference among the hybrids in the number of green leaves per plant at all stages of the crop growth. However, BH 40625 hybrid was found superior to BH 1576 and Super 900M.

Similarly, effect of different nitrogen levels on number of green leaves per plant was found to be non significant at all the crop growth stages. There was marginal increase due to increasing levels of nitrogen.

The interaction between hybrids and nitrogen levels was not significant.

#### **4.4 LEAF AREA INDEX (LAI)**

Perusal of the data LAI (table 5) indicated that leaf area index tended to increase up to 60 DAS beyond which it declined towards harvest. The maize hybrids differed significantly in terms of LAI. The hybrid BH 40625 recorded significantly more LAI over BH 1576 and Super 900M at all the stages. The increase in LAI due to BH 40625 over BH 1576 and Super 900 M at harvest was 28% and 14 % respectively.

Similarly, LAI was influenced markedly due to N levels. Increasing levels of nitrogen from 150 to 300 kg ha<sup>-1</sup> significantly increased LAI at all the stages. Maximum LAI of 1.95 was found with 300 kg N ha<sup>-1</sup> followed by 250 kg N ha<sup>-1</sup> with 1.70 at harvest. The lowest LAI of 1.21 was observed at 150 kg N ha<sup>-1</sup>.

The interaction was significant and revealed that all the three hybrids shown significant and positive response to increasing levels of nitrogen (Appendix 2,3, and 4).

#### **4.5 DRY MATTER PRODUCTION**

The dry matter yield recorded at different stages as influenced by treatments is presented in table 6 and shown in fig.5.

The results revealed that the maize hybrids did not differ significantly in terms of dry matter production at any stage of crop growth. The response of the

three hybrids was almost equal. However, the hybrid BH 40625 was found efficient in producing more dry matter over the other two hybrids. A maximum dry matter of 378, 6552 and 15522 kg ha<sup>-1</sup> was observed with BH 40625 at 30,60 DAS and at harvest respectively.

The lowest dry matter production was found with BH 1576 .BH 40625 and the hybrid Super 900 M was better over BH 1576.

The dry matter yield was significantly influenced by nitrogen levels at all the stages. Increasing level of nitrogen from 150 to 300 kg ha<sup>-1</sup> brought significant improvement in dry matter at all the stages . Maximum dry matter of 381, 7405 and 16136 kg ha<sup>-1</sup> was recorded by 300 kg ha<sup>-1</sup> at 30, 60 DAS and at harvest respectively. The present increase in dry matter yield due to 300 kg N ha<sup>-1</sup> over 150, 200 and 250 kg N ha<sup>-1</sup> were in the order of 2258,1030 and 462 kg ha<sup>-1</sup>.

The interaction effect on dry matter yield was non significant.

#### **4.6 Days to 50 % silking**

The data on days to50 % silking is presented in the table 7.The results indicated that maize hybrids differed significantly with regard to days taken to 50 per cent silking. Earliest silking (72 days) was observed in BH 40625. The hybrid BH 1576 took more number of days to 50 per cent silking (74 days) over the hybrid superior to Super 900 M (73 days) (Table 7).

Increasing level of nitrogen from 150-300 kg ha<sup>-1</sup> progressively reduced the days to 50 per cent silking. Early silking observed at higher nitrogen levels maximum days to 50 per cent silking (70 days) was found with 300 kg ha<sup>-1</sup> of nitrogen while 250 kg ha<sup>-1</sup> nitrogen recorded 72 days. Delayed silking occurred due to the lowest level of nitrogen i.e. 150 kg ha<sup>-1</sup>.

The difference in days to 50% silking between 300 and 150 kg N ha<sup>-1</sup>.was 5.6 days

The interaction effect of varieties and nitrogen levels did not influence the number of days to 50 per cent silking.

#### **4.6.1 Days to physiological maturity**

Study of the data on days to physiological maturity (table 7) indicated that maize hybrids did not differ significantly with regard to days to physiological maturity. However among the hybrids days to physiological maturity (122 days) were taken by BH 40625 followed by BH 1576. The hybrid BH 40625 took two days more than the (124) other two hybrids to attain physiological maturity stage.

Among different nitrogen levels, days to physiological maturity did not vary significantly.

The interaction effect of varieties and nitrogen levels on days to physiological maturity of maize was found to be not significant.

## **4.7 YIELD ATTRIBUTES AND YIELD**

### **4.7.1 Cob Length**

The data on cob length as influenced by different treatments is presented in table 8. It was found that all the three hybrids differed significantly among themselves regarding cob length. The maximum cob length was recorded by BH 40625 (17.5cm) which was significantly superior to BH 1576 (16.8 cm) and on par with Super 900 M (17.3 cm) .

The cob length was significantly influenced by nitrogen levels. Significantly highest cob length (17.9 cm) was obtained with 300 kg ha<sup>-1</sup> of nitrogen which was superior to rest of the levels. It was followed by 250 kg ha<sup>-1</sup> of nitrogen with cob length of 17.2cm. The cob length recorded by 150 kg (16.7 cm) nitrogen application was on par with the cob length recorded at 200 kg ha<sup>-1</sup> (17.0 cm) .

The interaction effect of hybrids and nitrogen levels on cob length of maize was found to be not significant.

### **4.7.2 Cob Girth**

Study of the data in detail revealed that the cob girth recorded by three hybrids namely BH 40625, BH 1576 and Super 900 M was on par with each other (Table 8).

Effect of different nitrogen levels on cob girth indicated that application of increased level of nitrogen from 150-300 kg ha<sup>-1</sup> progressively increased the cob girth.

Perusal of cob girth data inferred that significant differences were existed among all the levels of nitrogen. The highest cob girth of 15.1cm was obtained at 300 kg N ha<sup>-1</sup> level which was significantly superior to the cob girth obtained with 150 kg N ha<sup>-1</sup> (14.1 cm) and 200 kg N ha<sup>-1</sup> (14.4 cm) and on par with that of the cob girth obtained from 250 kg N ha<sup>-1</sup> (14.7 cm). Cob girth recorded by 150 kg N ha<sup>-1</sup> (14.1 cm) was the lowest but it was on par with 200 kg N ha<sup>-1</sup> (14.4 cm).

The results reveal that all the three hybrids tested responded equally to higher level of nitrogen i.e. up to 300 kg ha<sup>-1</sup>. The interaction effect of hybrids and nitrogen levels was not significant.

#### **4.7.3 Number of grain rows per cob**

Study of the data in detail revealed that the number of grain rows per cob recorded by three hybrids namely BH 40625, BH 1576 and Super 900 M did not differ significantly with each other. Maximum number of rows per cob were observed with BH 40625 (Table 8).

The effect of different nitrogen levels on number of grain rows per cob indicated that application of increased level of nitrogen from 150 to 300 kg ha<sup>-1</sup> progressively increased the number of grain rows per cob. Perusal of the data on

number of grain rows per cob inferred that significant differences existed among different levels of nitrogen. The highest number of grain rows per cob (15.6) was obtained at 300 kg N ha<sup>-1</sup> which was significantly superior to other doses of nitrogen application. The number of grain rows per cob obtained with 150 kg N ha<sup>-1</sup> was significantly lower compared to 200, 250 and 300 kg N ha<sup>-1</sup>.

However the interaction effect of hybrids and nitrogen levels was not significant.

#### **4.7.4 Number of grains per cob**

Maize hybrids did not differ among themselves significantly in number of grains cob<sup>-1</sup>. The maximum number of grains cob<sup>-1</sup> (508.7) was recorded by the hybrid BH 40625 followed by Super 900M (506.8) and BH 1576 (502.3) (Table 8)

The number of grains cob<sup>-1</sup> was significantly influenced by nitrogen levels. Significantly highest number of seeds cob<sup>-1</sup> (547.2) was obtained with 300 kg ha<sup>-1</sup> of nitrogen which was superior to rest of the treatments. Next to 300 kg N ha<sup>-1</sup> level, 250 kg N ha<sup>-1</sup> of nitrogen recorded more number of grains cob<sup>-1</sup>. The number of grains cob<sup>-1</sup> (454.7) recorded by 150 kg N ha<sup>-1</sup> was significantly inferior to rest of the levels.

The interaction effect of hybrids and nitrogen levels on number of grains cob<sup>-1</sup> was found to be non significant.

#### **4.7.5 100 grain weight**

Maize hybrids differed significantly in terms of 100 grain weight. The hybrid BH 40625 recorded the highest 100 grain weight (30.9 g) which was significantly superior to Super 900 M (29.8 g) and BH 1576 (29.6 g). The two hybrids namely 1576 and Super 900 M were at par.

The effect of different nitrogen levels on 100 grain weight indicated that application of increased level of nitrogen from 150 to 300 kg N ha<sup>-1</sup> progressively increased the 100 grain weight. It was found that 100 grain weight differed significantly due to levels of nitrogen. Maximum 100 grain weight of 31.9 gm was recorded by 300 kg N ha<sup>-1</sup> level which was on par with that of 250 kg N ha<sup>-1</sup> (31.2 g) and significantly superior to 150 kg and 200 kg N ha<sup>-1</sup>. Minimum 100 grain weight was recorded by 150 kg N ha<sup>-1</sup> (27.9 g).

The results indicated that all the three hybrids tested responded equally to higher level of nitrogen i.e. up to 300 kg ha<sup>-1</sup>. The interaction effect of hybrids and nitrogen levels was not significant.

#### **4.7.6 Shelling Percentage**

Perusal of the data revealed that the different hybrids differed significantly in respect of shelling percentage. Significantly higher shelling percentage (72 %) was recorded by BH 40625 over other hybrids. Where as the lowest shelling percentage was found with BH 1576 (70.90 %) (table 9 and fig.8).

Regarding the effect of different nitrogen levels on shelling percentage it was observed that application of increased level of nitrogen from 150 to 300 kg ha<sup>-1</sup> significantly increased the shelling percentage. It was found that that significant differences were existed among all nitrogen levels of nitrogen. The highest shelling percentage of 73.5 % was obtained at 300 kg N ha<sup>-1</sup> level followed by 250 kg N ha<sup>-1</sup> (71.7 %), 200 kg N ha<sup>-1</sup> (70.6) and 150 kg N ha<sup>-1</sup> (70.0%).

The interaction effect of varieties and nitrogen levels on shelling percentage of maize was found to be non significant.

#### **4.7.7 Grain Yield**

The data on grain yield of maize as influenced by different treatments are presented in table and illustrated in figures. Study of the data in detail revealed that grain yield recorded by three hybrids namely BH 1576, Super 900 M and BH 1576 were found to at par and the differences among themselves did not attain the level of significance. However the hybrid BH 40625 recorded the maximum grain yield of 6700 kg ha<sup>-1</sup> followed by Super 900 M (6557 kg ha<sup>-1</sup>) and BH 1576 (6456 kg ha<sup>-1</sup>) (table 9 and fig.8). The yield advantage due to BH 4065 over Super 900M was in the order of 143 and 244 kg ha<sup>-1</sup> respectively.

Regarding the effect of different nitrogen levels on grain yield indicated that application of increased level of nitrogen from 150 to 300 kg ha<sup>-1</sup> markedly increased the grain yield.

Perusal of yield data inferred that significant differences were existed among the levels of nitrogen. Significantly highest grain yield of 7003 kg ha<sup>-1</sup> was obtained at 300 kg N ha<sup>-1</sup> which was more by 1044 kg ha<sup>-1</sup> over 150 kg level .The rate of yield increase was maximum with 200 kg N ha<sup>-1</sup> over 150 kg N ha<sup>-1</sup>.

The interaction effect of hybrids and nitrogen levels on grain yield of maize was not significant.

#### **4.7.8 Stover Yield**

The data on stover yield as influenced by different treatments are presented in table and illustrated in figures. Study of the data in detail revealed that stover yield recorded by three hybrids namely BH 40625, BH 1576 and Super 900 M varied significantly. The hybrid BH 40625 recorded the highest stover yield of 8805 kg ha<sup>-1</sup> followed by Super 900 M (8637 kg ha<sup>-1</sup>) and BH 1576 (8562 kg ha<sup>-1</sup>) (table 9 and fig.8). The increase in stover yield due to BH 4065 over Super 900 M and BH 1576 was 168 and 243 kg ha<sup>-1</sup> respectively

The results indicated that application of increased level of nitrogen from 150 to 300 kg ha<sup>-1</sup> progressively increased the stover yield significantly. Significant differences were existed among different levels of nitrogen. The highest stover yield of 9103 ha<sup>-1</sup> was obtained at 300 kg N ha<sup>-1</sup> level which was more by 1180 kg ha<sup>-1</sup> over 150 kg level. The rate of stover yield increase was maximum with 200 kg N over 150 kg N.

The interaction effect of hybrids and nitrogen levels on stover yield of maize was found to be non significant.

#### **4.7.9 Harvest index**

Study of the data (table 9) revealed that the Harvest Index was not influenced by different hybrids namely BH 40625, BH 1576 and super 900m. They performed at par with each other (table 9 and fig.8).

Harvest index was not affected due to increased level of nitrogen from 150 to 300 kg ha<sup>-1</sup> did not attain the values of significance. Similarly the interaction effect was not significant between hybrids and nitrogen levels .

#### **4.8 Protein content of maize grain**

Protein content differed significantly among hybrids and the highest protein content was recorded by BH 40625 ( 11.4 ), which was on par with Super 900 M (11.3), with a protein content significantly higher than that of BH 1576 ( 11.01 ) (table 10 and fig.8).

Increasing levels of nitrogen increased the protein content significantly. The results revealed that highest protein content of 11.8 % was obtained at 300 kg N ha<sup>-1</sup> level which was more by 1.6 over 150 kg level .Similarly application of 200 kg N ha<sup>-1</sup> over 150 kg N ha<sup>-1</sup> improved protein content significantly over 150 kg N ha<sup>-1</sup>

The interaction effect of hybrids and nitrogen levels on protein content of maize was found to be significant (Appendix -5).

## **4.9 NUTRIENT UPTAKE OF MAIZE**

### **4.9.1 Nitrogen uptake**

The maize hybrids and nitrogen levels as well as their interaction showed significant influence over nitrogen uptake of maize (table 12).

Nitrogen uptake differed significantly. Maximum nitrogen uptake was recorded by BH 40625 (151 kg N ha<sup>-1</sup>), followed by Super 900 M (146 kg ha<sup>-1</sup>) and BH 1576 (142 kg ha<sup>-1</sup>).

Nitrogen levels influenced nitrogen uptake of maize with distinct disparity between any two successive levels of nitrogen levels tried. 300 kg N ha<sup>-1</sup> recorded the highest nitrogen uptake (170 kg N ha<sup>-1</sup>) followed by 250 kg N ha<sup>-1</sup>, 200 kg N ha<sup>-1</sup> and 150 kg N ha<sup>-1</sup>. The lowest nitrogen uptake (126 kg N ha<sup>-1</sup>) was recorded with 150 kg N ha<sup>-1</sup> which was significantly lesser than rest of the nitrogen levels.

Regarding interaction effect, in all the three hybrids 300 kg N ha<sup>-1</sup> resulted in the highest nitrogen uptake (170.1 kg N ha<sup>-1</sup>) followed by 250 kg N ha<sup>-1</sup> (149.8 kg N ha<sup>-1</sup>). The lowest nitrogen uptake was obtained with 150 kg N ha<sup>-1</sup> (126.1 kg N ha<sup>-1</sup>) (Appendix -8)

#### **4.9.2 Phosphorus uptake**

Phosphorus uptake differed significantly due to different hybrids. The highest phosphorus uptake was recorded by BH 40625 (80.9 kg P ha<sup>-1</sup>), which was on par with Super 900 m (80.8 kg ha<sup>-1</sup>) (table 12).

Nitrogen levels influenced the phosphorus uptake of maize with distinct disparity between any two successive levels of nitrogen levels tried. Application of 300 kg N ha<sup>-1</sup> recorded the highest phosphorus uptake followed by 250 kg N ha<sup>-1</sup>, 200 kg N ha<sup>-1</sup> and 150 kg N ha<sup>-1</sup>. The lowest phosphorus uptake was recorded with 150 kg N ha<sup>-1</sup> which was significantly lesser than rest of the nitrogen levels.

The interaction effect revealed that in all the three hybrids 300 kg N ha<sup>-1</sup> resulted in the highest phosphorus uptake (90.7 kg P ha<sup>-1</sup>) followed by 250 kg N ha<sup>-1</sup> (85.5 kg P ha<sup>-1</sup>) The lowest phosphorus uptake was obtained with 150 kg N ha<sup>-1</sup> (70.7 kg P ha<sup>-1</sup>) (Appendix -9)

#### **4.9.3 Potassium uptake**

Potassium uptake also differed significantly due to both hybrids and nitrogen levels. Maximum potassium uptake was recorded by BH 40625 (157.3 kg K ha<sup>-1</sup>), followed by Super 900 M (152.8 kg K ha<sup>-1</sup>) which was on par with BH 1576 (149.7 kg K ha<sup>-1</sup>). The lowest potassium uptake was recorded with BH 1576 (149.7 kg ha<sup>-1</sup>), which was significantly lower than other two maize hybrids.

Application of 300 kg N ha<sup>-1</sup> recorded the maximum potassium uptake (169.5 kg K ha<sup>-1</sup>) followed by 250 kg N ha<sup>-1</sup>, 200 kg N ha<sup>-1</sup> and 150 kg N ha<sup>-1</sup>.

It was observed that all the hybrids shown that 300 kg N ha<sup>-1</sup> resulted in the highest potassium uptake (169.5 kg P ha<sup>-1</sup>) followed by 250 kg N ha<sup>-1</sup> (156.5 kg P ha<sup>-1</sup>). The lowest potassium uptake was obtained with 150 kg N ha<sup>-1</sup> (136.4 kg P ha<sup>-1</sup>) (Appendix -10)

#### **4.10 POST HARVEST SOIL ANALYSIS**

Soil samples collected after harvest of maize were analyzed for available nitrogen, available phosphorus (P<sub>2</sub>O<sub>5</sub>) and available potassium (K<sub>2</sub>O) contents. The data obtained were subjected to statistical analysis and the results are presented below:

##### **4.10.1 Post harvest soil available Nitrogen**

Maximum soil available nitrogen (220.9 kg ha<sup>-1</sup>) was observed with BH 1576 after crop harvest which was significantly more than the remaining two hybrids (table 11).

Among nitrogen levels tried, the maximum value of post harvest soil available nitrogen (239.9 kg ha<sup>-1</sup>) was found with 300 kg ha<sup>-1</sup> level of nitrogen, which was significantly more than the rest of the nitrogen levels.

The interaction effect of varieties and nitrogen levels on nitrogen content of soil was found to be significant (Appendix -6)

#### **4.10.2 Post-harvest Soil Available Phosphorus ( $P_2O_5$ )**

The highest quantity of soil available Phosphorus ( $35.65 \text{ kg ha}^{-1}$ ) was recorded with BH 1576 which was significantly more than the remaining two treatments. Super 900 M was the next ( $32.9 \text{ kg ha}^{-1}$ ) while the lowest amount of soil available Phosphorus ( $31.8 \text{ kg ha}^{-1}$ ) was noticed with BH 40625 (table 11 ).

The highest value of post harvest soil available Phosphorus ( $41.2 \text{ kg ha}^{-1}$ ) was obtained with  $150 \text{ kg ha}^{-1}$  level of nitrogen, which was significantly more than the rest of the treatments.

The interaction effect of varieties and nitrogen levels on phosphorus content of soil was significant (Appendix -7)

#### **4.10.3 Post harvest soil available Potassium ( $K_2O$ )**

Maize hybrids and nitrogen levels exerted no significant influence on the soil available potassium ( $K_2O$ ) but the interaction had no influence on this character at harvest.

The highest post harvest soil available potassium ( $246.8 \text{ kg ha}^{-1}$ ) was recorded with hybrid BH 1576 which was significantly more than the remaining two treatments. BH 40625 was the next ( $225.2 \text{ kg ha}^{-1}$ ). While the least post harvest soil available potassium ( $211.7 \text{ kg ha}^{-1}$ ) was obtained with hybrid Super 900 M (table 11).

Nitrogen levels differed significantly in their influence on soil available potassium ( $K_2O$ ) at harvest. Application of  $300 \text{ kg ha}^{-1}$  level of nitrogen resulted in significantly lower post harvest soil available potassium ( $190.8 \text{ kg ha}^{-1}$ ) followed by  $250 \text{ kg ha}^{-1}$  recommended dose of nitrogen with  $231.8 \text{ kg ha}^{-1}$ .

The interaction of varieties and nitrogen levels did not show any significant effect on post harvest soil available potassium status.

#### **4.11 ECONOMICS**

##### **4.12 Gross Returns**

Higher gross returns ( $\text{Rs.}59680 \text{ ha}^{-1}$ ) were realized by BH 40625 which was comparable with Super 900 M ( $\text{Rs.}58414 \text{ ha}^{-1}$ ) and BH 1576 ( $\text{Rs.}57414 \text{ ha}^{-1}$ ).

Gross returns showed noticeable variation due to the nitrogen levels tried and significantly highest gross return ( $\text{Rs.}62329/-$ ) were obtained with  $300 \text{ kg ha}^{-1}$  recommended dose of nitrogen, which was superior to rest of the levels. This was followed by  $250 \text{ kg ha}^{-1}$  level of nitrogen, with  $\text{Rs.}60342/-$  and the lowest gross return ( $\text{Rs.}53172/-$ ) were obtained under  $150 \text{ kg ha}^{-1}$  nitrogen level.

##### **4.11 Net Returns**

Higher net returns ( $\text{Rs.}41714 \text{ ha}^{-1}$ ) were obtained by BH 40625 which was comparable with Super 900 M ( $\text{Rs.}40448 \text{ ha}^{-1}$ ) and BH 1576 ( $\text{Rs.}39448 \text{ ha}^{-1}$ ).

Net returns showed considerable variation due to the nitrogen levels indicating that significantly high net returns ( $\text{Rs.}43571/-$ ) were obtained by  $300 \text{ kg}$

ha<sup>-1</sup> level of nitrogen, followed by 250 kg ha<sup>-1</sup> with Rs.42127/- and the lowest net returns (Rs.39953/-) were obtained with 150 kg ha<sup>-1</sup> nitrogen level.

#### **4.11 Benefit Cost Ratio (B: C ratio)**

With regard to varieties, BH 40625 recorded the highest B:C ratio (2.32) which was on par with BH 1576 (2.25) and Super 900 M (2.19).

In case of nitrogen levels, benefit – cost ratio was on par with 150, 200,250 and 300 Kg ha<sup>-1</sup> of N (Appendix -11).

Table 2: Initial and final plant population ('00oha<sup>-1</sup>) as influenced by maize hybrids in relation to nitrogen levels

Treatment	Initial plant population ('00oha <sup>-1</sup> )	Final plant population ('00oha <sup>-1</sup> )
<b>Hybrids</b>		
BH 1576	65.4	64.7
Super 900 M	65.3	64.3
BH 40625	66.0	65.2
SEm ±	0.27	0.24
CD ( P= 0.05)	NS	NS
<b>Nitrogen levels (kg ha<sup>-1</sup>)</b>		
150	65.1	64.4
200	65.4	64.2
250	65.7	64.6
300	66.1	65.3
SEm ±	0.34	0.23
CD ( P= 0.05)	NS	NS
<b>V X N Interaction</b>		
SEm ±	0.59	0.34
(a)CD ( P= 0.05)	NS	NS
SEm ±	0.55	0.33
(b)CD ( P= 0.05)	NS	NS

- (a) Between two sub treatment means at same level of main treatment  
(b) Between two main treatment means at same level or different levels of sub treatments

Table 3: Plant height (cm) as influenced by Maize hybrids in relation to nitrogen levels at different stages

Treatment	Plant height (cm)		
	30 DAS	60DAS	At harvest
<b>Hybrids</b>			
BH 1576	30.9	125.2	202.5
Super 900 M	31.0	126.5	204.9
BH 40625	32.0	129.9	206.6
SEm ±	0.69	2.88	0.95
CD ( P= 0.05)	NS	NS	2.65
<b>Nitrogen levels (kg ha<sup>-1</sup>)</b>			
150	29.7	119.8	192.9
200	30.7	125.5	200.2
250	31.8	130.2	208.7
300	33.3	133.3	216.9
SEm ±	0.34	1.00	1.68
CD ( P= 0.05)	0.71	2.11	3.53
<b>V X N Interaction</b>			
SEm ±	0.58	1.74	2.91
(a)CD ( P= 0.05)	NS	NS	NS
SEm ±	1.23	5.07	2.20
(b)CD ( P= 0.05)	NS	NS	NS

(a) Between two sub treatment means at same level of main treatment

(b) Between two main treatment means at same level or different levels of sub treatments



Table 4: Number of green leaves per plant as influenced by maize hybrids in relation to nitrogen levels

Treatment	Number of green leaves plant <sup>-1</sup>		
	30 DAS	60DAS	At harvest
<b>Hybrids</b>			
BH 1576	7.90	12.50	4.50
Super 900 M	7.90	12.60	4.60
BH 40625	8.00	12.80	5.00
SEm ±	0.19	0.35	0.12
CD ( P= 0.05)	NS	NS	NS
<b>Nitrogen levels (kg ha<sup>-1</sup>)</b>			
150	7.70	12.60	4.60
200	7.90	12.60	4.60
250	7.90	12.60	4.70
300	8.10	12.80	4.80
SEm ±	0.15	0.24	0.15
CD ( P= 0.05)	NS	NS	NS
<b>V X N Interaction</b>			
SEm ±	0.27	0.42	0.26
(a)CD ( P= 0.05)	NS	NS	NS
SEm ±	0.36	0.65	0.25
(b)CD ( P= 0.05)	NS	NS	NS

- (a) Between two sub treatment means at same level of main treatment
- (b) Between two main treatment means at same level or different levels of sub treatments

Table 5: leaf area index as influenced by maize hybrids in relation to nitrogen levels

Treatment	leaf area index		
	30DAS	60 DAS	90 DAS
<b>Hybrids</b>			
BH 1576	0.61	3.08	1.39
Super 900 M	0.62	3.21	1.57
BH 40625	0.79	3.33	1.79
SEm ±	0.01	0.05	0.05
CD ( P= 0.05)	0.04	0.14	0.15
<b>Nitrogen levels (kg ha<sup>-1</sup>)</b>			
150	0.54	2.76	1.21
200	0.63	3.06	1.48
250	0.71	3.33	1.70
300	0.81	3.68	1.95
SEm ±	0.01	0.03	0.03
CD ( P= 0.05)	0.02	0.06	0.07
<b>V X N Interaction</b>			
SEm ±	0.01	0.05	0.06
(a)CD ( P= 0.05)	0.03	0.11	0.13
SEm ±	0.02	0.09	0.10
(b)CD ( P= 0.05)	0.06	0.24	0.24

- (a) Between two sub treatment means at same level of main treatment  
(b) Between two main treatment means at same level or different levels of sub treatments

Table 6: Dry matter production ( $\text{kg ha}^{-1}$ ) as influenced by maize hybrids in relation to nitrogen levels

Treatment	Dry matter production ( $\text{kg ha}^{-1}$ )		
	30DAS	60 DAS	At harvest
<b>Hybrids</b>			
BH 1576	291	6003	14887
Super 900 M	327	6277	15187
BH 40625	378	6552	15522
SEm $\pm$	18.75	195.5	244.1
CD ( P= 0.05)	NS	NS	NS
<b>Nitrogen levels (<math>\text{kg ha}^{-1}</math>)</b>			
150	289	5275	13878
200	323	5906	15106
250	333	6522	15674
300	381	7405	16136
SEm $\pm$	11.22	238.5	143
CD ( P= 0.05)	23.58	501.05	301.3
<b>V X N Interaction</b>			
SEm $\pm$	19.44	413.06	248.4
(a)CD ( P= 0.05)	NS	NS	NS
SEm $\pm$	33.90	396.69	440.7
(b)CD ( P= 0.05)	NS	NS	NS

(a) Between two sub treatment means at same level of main treatment

(b) Between two main treatment means at same level or different levels of sub treatments

Table 7: Days to 50 per cent silking and days to physiological maturity as influenced by maize hybrids in relation to nitrogen levels

Treatment	Days to 50% silking	Days to physiological maturity
<b>Hybrids</b>		
BH 1576	74	123
Super 900 M	73	122
BH 40625	72	124
SEm ±	0.27	0.21
CD ( P= 0.05)	NS	NS
<b>Nitrogen levels (kg ha<sup>-1</sup>)</b>		
150	76	122
200	74	123
250	72	123
300	70	123
SEm ±	0.60	0.34
CD ( P= 0.05)	NS	NS
<b>V X N Interaction</b>		
SEm ±	1.05	0.60
(a)CD ( P= 0.05)	NS	NS
SEm ±	0.70	0.47
(b)CD ( P= 0.05)	NS	NS

(a) Between two sub treatment means at same level of main treatment

(b) Between two main treatment means at same level or different levels of sub treatments

Table 9: Grain and stover yields ( $\text{kg ha}^{-1}$ ) of maize as influenced by hybrids and nitrogen levels

Treatment	Grain yield ( $\text{kg ha}^{-1}$ )	Stover yield ( $\text{kg ha}^{-1}$ )	Shelling (%)	Harvest index (%)
<b>Hybrids</b>				
BH 1576	6456	8562	70.90	42.90
Super 900 M	6557	8637	71.40	43.10
BH 40625	6700	8805	72.00	43.10
SEm $\pm$	152.2	95.03	0.21	0.41
CD ( P= 0.05)	NS	NS	NS	NS
<b>Nitrogen levels (<math>\text{kg ha}^{-1}</math>)</b>				
150	5959	7922	70.0	42.9
200	6543	8544	70.6	43.2
250	6778	8835	71.8	43.4
300	7003	9103	73.5	43.5
SEm $\pm$	76.71	65.7	0.22	0.25
CD ( P= 0.05)	150.35	138.1	0.46	0.53
<b>V X N Interaction</b>				
SEm $\pm$	132.87	113.8	0.38	0.43
(a)CD ( P= 0.05)	NS	NS	NS	NS
SEm $\pm$	271.95	174.2	0.41	0.74
(b)CD ( P= 0.05)	NS	NS	NS	NS

(a) Between two sub treatment means at same level of main treatment

(b) Between two main treatment means at same level or different levels of sub treatments

Table 8: Yield attributes of maize as influenced by hybrids and nitrogen levels

Treatment	Length of the cob (cm)	Girth of the cob (cm)	No. of grain rows per cob	No. of grains per cob	100 grain weight (gm)
<b>Hybrids</b>					
BH 1576	16.80	14.50	14.40	502.30	29.60
Super 900 M	17.30	14.60	15.10	506.80	29.80
BH 40625	17.50	14.60	15.40	508.70	30.90
SEm ±	0.21	0.41	0.30	15.1	0.21
CD ( P= 0.05)	0.60	NS	NS	NS	0.58
<b>Nitrogen levels (kg ha<sup>-1</sup>)</b>					
150	16.70	14.10	14.40	454.70	27.90
200	17.00	14.40	14.90	503.20	29.40
250	17.20	14.70	15.00	532.00	31.20
300	17.90	15.10	15.60	547.20	31.90
SEm ±	0.20	0.31	0.25	5.23	0.54
CD ( P= 0.05)	0.43	0.66	0.53	10.99	1.14
<b>V X N Interaction</b>					
SEm ±	0.36	0.54	0.43	9.06	0.94
(a)CD ( P= 0.05)	NS	NS	NS	NS	NS
SEm ±	0.42	0.76	0.56	26.60	0.59
(b)CD ( P= 0.05)	NS	NS	NS	NS	NS

(a) Between two sub treatment means at same level of main treatment

(b) Between two main treatment means at same level or different levels of sub treatments

Table 11: Available nutrients status of the soil ( kg ha<sup>-1</sup>) after harvest of Maize crop as influenced by treatments

Treatment	Nutrients status of the soil (kg ha <sup>-1</sup> ) after harvest		
	Nitrogen	Phosphorus	Potassium
<b>Hybrids</b>			
BH 1576	220.90	35.60	246.8
Super 900 M	216.80	32.90	211.70
BH 40625	214.20	31.80	225.20
SEm ±	0.20	0.06	11.19
CD ( P= 0.05)	0.57	0.16	31.06
<b>Nitrogen levels (kg ha<sup>-1</sup>)</b>			
150	191.60	41.20	247.40
200	208.20	35.30	241.30
250	229.50	32.00	231.80
300	239.90	25.40	190.80
SEm ±	0.15	0.04	13.67
CD ( P= 0.05)	0.33	0.09	28.73
<b>V X N Interaction</b>			
SEm ±	0.27	0.08	23.6
(a)CD ( P= 0.05)	0.57	0.17	NS
SEm ±	0.38	0.11	22.7
(b)CD ( P= 0.05)	0.92	0.27	NS
<b>Initial status of the soil</b>	222.75	22.6	260.7

(a) Between two sub treatment means at same level of main treatment

(b) Between two main treatment means at same level or different levels of sub treatments

Table 12: Nitrogen, Phosphorus and Potassium uptake ( $\text{kg ha}^{-1}$ ) by maize as influenced by treatments

Treatment	NPK uptake ( $\text{kg ha}^{-1}$ )		
	Nitrogen	Phosphorus	Potassium
<b>Hybrids</b>			
BH 1576	142.60	78.40	149.70
Super 900 M	146.30	80.80	152.80
BH 40625	151.10	80.90	157.30
SEm $\pm$	0.51	0.05	0.42
CD ( P= 0.05)	1.43	0.16	1.18
<b>Nitrogen levels (<math>\text{kg ha}^{-1}</math>)</b>			
150	126.10	70.66	136.41
200	140.70	73.16	150.56
250	149.80	85.50	156.50
300	170.10	90.66	169.51
SEm $\pm$	0.55	0.09	0.19
CD ( P= 0.05)	1.16	0.20	0.41
<b>V X N Interaction</b>			
SEm $\pm$	0.95	0.16	0.34
(a)CD ( P= 0.05)	2.01	0.35	0.71
SEm $\pm$	1.01	0.13	0.75
(b)CD ( P= 0.05)	2.32	0.28	1.94

(a) Between two sub treatment means at same level of main treatment

(b) Between two main treatment means at same level or different levels of sub treatments

Table 10: Protein content of grain as influenced by maize hybrids in relation to nitrogen levels

<b>Treatment</b>	<b>Protein %</b>
<b>Hybrids</b>	
BH 1576	11.00
Super 900 M	11.30
BH 40625	11.40
SEm ±	0.01
CD ( P= 0.05)	0.04
<b>Nitrogen levels (kg ha<sup>-1</sup>)</b>	
150	10.20
200	11.20
250	11.70
300	11.80
SEm ±	0.03
CD ( P= 0.05)	0.06
<b>V X N Interaction</b>	
SEm ±	0.05
(a)CD ( P= 0.05)	0.11
SEm ±	0.03
(b)CD ( P= 0.05)	0.08

## Appendix -2

Leaf area index as influenced by maize hybrids in relation to nitrogen levels at 30 DAS

Varieties	Leaf area index at 30 DAS				Mean
	Nitrogen levels (kg ha <sup>-1</sup> )				
	150	200	250	300	
BH 1576	0.51	0.56	0.64	0.72	0.61
Super 900 M	0.51	0.56	0.65	0.76	0.62
BH 40625	0.62	0.76	0.85	0.94	0.79
Mean	0.54	0.63	0.71	0.81	

	S.Em .±	CD ( 0.05)
Two main treatment means	0.01	0.04
Two sub treatment means	0.01	0.02
Two sub treatment means at same level of main treatment	0.02	0.04
Two main treatment means at same level or different levels of sub treatments	0.02	0.07

### Appendix -3

Leaf area index as influenced by maize hybrids in relation to nitrogen levels at 60 DAS

Varieties	Leaf area index at 60 DAS				Mean
	Nitrogen levels (kg ha <sup>-1</sup> )				
	150	200	250	300	
BH 1576	2.63	2.83	3.23	3.63	3.1
Super 900 M	2.73	3.13	3.35	3.65	3.2
BH 40625	2.93	3.23	3.41	3.8	3.3
Mean	2.8	3.1	3.3	3.7	

	S.Em .±	CD ( 0.05)
Two main treatment means	0.05	0.14
Two sub treatment means	0.03	0.06
Two sub treatment means at same level of main treatment	0.05	0.11
Two main treatment means at same level or different levels of sub treatments	0.09	0.24

#### Appendix -4

Leaf area index at 90 DAS as influenced by maize hybrids in relation to nitrogen levels

Varieties	Leaf area index at 90 DAS				Mean
	Nitrogen levels (kg ha <sup>-1</sup> )				
	150	200	250	300	
BH 1576	1.10	1.21	1.50	1.76	1.39
Super 900 M	1.22	1.56	1.66	1.83	1.57
BH 40625	1.31	1.66	1.93	2.26	1.79
Mean	1.21	1.48	1.70	1.95	

	S.Em .±	CD ( 0.05)
Two main treatment means	0.05	0.15
Two sub treatment means	0.03	0.07
Two sub treatment means at same level of main treatment	0.06	0.13
Two main treatment means at same level or different levels of sub treatments	0.10	0.24

Appendix -5

Protein content of grain as influenced by maize hybrids in relation to nitrogen levels

Varieties	Protein content of grain (%)				Mean
	Nitrogen levels (kg ha <sup>-1</sup> )				
	150	200	250	300	
BH 1576	9.6	11.1	11.6	11.8	11.01
Super 900 M	10.3	11.2	11.8	11.8	11.3
BH 40625	10.6	11.3	11.8	12.0	11.4
Mean	10.2	11.2	11.7	11.8	

	S.Em .±	CD ( 0.05)
Two main treatment means	0.01	0.04
Two sub treatment means	0.03	0.06
Two sub treatment means at same level of main treatment	0.05	0.11
Two main treatment means at same level or different levels of sub treatments	0.04	0.08

Appendix -6

Available nitrogen in soil ( $\text{kg ha}^{-1}$ ) at harvest as influenced by hybrids and nitrogen levels

Varieties	Available nitrogen in soil ( $\text{kg ha}^{-1}$ ) at harvest				Mean
	Nitrogen levels ( $\text{kg ha}^{-1}$ )				
	150	200	250	300	
BH 1576	195.1	212.9	232.1	243.6	220.9
Super 900 M	190	206.6	231.1	239.3	216.8
BH 40625	189.6	205.2	225.2	236.7	214.2
Mean	191.6	208.2	229.5	239.9	

	S.Em $\pm$	CD ( 0.05)
Two main treatment means	0.2	0.57
Two sub treatment means	0.15	0.33
Two sub treatment means at same level of main treatment	0.27	0.57
Two main treatment means at same level or different levels of sub treatments	0.38	0.92

Appendix -7

Available phosphorus in soil ( $\text{kg ha}^{-1}$ ) at harvest as influenced by hybrids and nitrogen levels

Varieties	Available phosphorus in soil ( $\text{kg ha}^{-1}$ ) at harvest				Mean
	Nitrogen levels ( $\text{kg ha}^{-1}$ )				
	150	200	250	300	
BH 1576	43.45	37.75	33.75	27.65	35.65
Super 900 M	40.60	34.70	31.75	24.80	32.96
BH 40625	39.70	33.55	30.55	23.70	31.87
Mean	41.25	35.33	32.01	25.65	

	S.Em $\pm$	CD ( 0.05)
Two main treatment means	0.06	0.16
Two sub treatment means	0.04	0.09
Two sub treatment means at same level of main treatment	0.08	0.17
Two main treatment means at same level or different levels of sub treatments	0.11	0.27

Appendix -8

Nitrogen uptake ( $\text{kg ha}^{-1}$ ) of maize as influenced by hybrids and nitrogen levels.

Varieties	Nitrogen uptake ( $\text{kg ha}^{-1}$ )				Mean
	Nitrogen levels ( $\text{kg ha}^{-1}$ )				
	150	200	250	300	
BH 1576	123.1	137.1	145.6	164.5	142.6
Super 900 M	124.1	141.6	150.0	169.6	146.3
BH 40625	131.1	143.4	153.7	176.1	151.1
Mean	126.1	140.7	149.8	170.1	

	S.Em $\pm$	CD ( 0.05)
Two main treatment means	0.51	1.43
Two sub treatment means	0.55	1.16
Two sub treatment means at same level of main treatment	0.95	2.01
Two main treatment means at same level or different levels of sub treatments	1.01	2.32

### Appendix -9

Phosphorus uptake ( $\text{kg ha}^{-1}$ ) of maize as influenced by  $\text{Kg ha}^{-1}$  hybrids and nitrogen levels.

Varieties	Phosphorus uptake ( $\text{kg ha}^{-1}$ )				Mean
	Nitrogen levels ( $\text{kg ha}^{-1}$ )				
	150	200	250	300	
BH 1576	69.0	71.5	83.5	89.5	78.4
Super 900 M	71.5	73.5	87.5	91.0	80.8
BH 40625	71.5	74.5	85.5	91.5	80.8
Mean	70.7	73.2	85.5	90.7	

	S.Em $\pm$	CD ( 0.05)
Two main treatment means	0.05	0.16
Two sub treatment means	0.09	0.20
Two sub treatment means at same level of main treatment	0.16	0.35
Two main treatment means at same level or different levels of sub treatments	0.13	0.28

Appendix -10

Potassium uptake ( $\text{kg ha}^{-1}$ ) of maize as influenced by  $\text{Kg ha}^{-1}$  hybrids and nitrogen levels.

Varieties	Potassium uptake ( $\text{kg ha}^{-1}$ )				Mean
	Nitrogen levels ( $\text{kg ha}^{-1}$ )				
	150	200	250	300	
BH 1576	132.7	147.6	153.5	165.1	149.7
Super 900 M	136.5	149.4	155.5	169.8	152.8
BH 40625	140.2	154.7	160.5	173.7	157.3
Mean	136.4	150.6	156.5	169.5	

	S.Em $\pm$	CD ( 0.05)
Two main treatment means	0.42	1.18
Two sub treatment means	0.19	0.41
Two sub treatment means at same level of main treatment	0.34	0.71
Two main treatment means at same level or different levels of sub treatments	0.75	1.94

## Appendix -11

Economics of maize as influenced by hybrids and nitrogen levels.

Treatment	Cost of cultivation (Rs ha <sup>-1</sup> )	Gross returns (Rs ha <sup>-1</sup> )	Net returns (Rs ha <sup>-1</sup> )	Benefit: Cost ratio
<b>Hybrids</b>				
BH 1576	17966	57414	39448	2.19:1
Super 900 m	17966	58414	40448	2.25:1
BH 40625	17966	59680	41714	2.32:1
<b>Nitrogen levels ( Kg ha<sup>-1</sup>)</b>				
150	17219	53172	39953	2.32:1
200	17672	58253	40851	2.31:1
250	18215	60342	42127	2.31:1
300	18758	62329	43571	2.32:1



## **CHAPTER – V**

### **DISCUSSION**

Maize is an important cereal crop of Andhra Pradesh possessing high production potential under favourable conditions. However the average yields in farmers' fields were found to be generally low due to insufficient and non adoption of improved varieties. On the other hand, maize is found to be a heavy feeder of nutrients particularly nitrogen. Management of fertilizer N for maize has been shown to have profound influence on crop yield. Like wise identification of a suitable variety for a given region plays an important role in maximizing the productivity. The present study was therefore aimed to evaluate the performance of hybrids Super 900 M, BH 1576, BH 40625 under different levels of nitrogen viz., 150, 200, 250, and 300 kg ha<sup>-1</sup>.

#### **5.1 WEATHER DURING THE CROP PERIOD**

Every crop has its characteristic cardinal limits of climatic parameters to realize potential yield. But those conditions seldom prevail in the field during crop growing season. If the fluctuations in climatic parameters are too wide, nutrient availability becomes a problem and the crop plants fail to adjust to the prevailing weather conditions, leading to poor growth and development of the crop.

However, the weather conditions at the time of sowing and up to two weeks after sowing of the maize crop remained congenial for germination and seedling

emergence but from the second fortnight of December, minimum temperatures dropped below 15°C and remained low up to first fortnight of January (Appendix-1). The maximum and minimum temperatures, relative humidity, wind speed and bright sun shine hours recorded during crop growth period were congenial for crop growth and development the crop was not affected by any pests and diseases, since prophylactic protection measures were taken ( Appendix-1)

## **5.2 PERFORMANCE OF MAIZE CULTIVARS**

Initial and final plant stand of maize was not significantly differed with the hybrids and nitrogen levels (Table 2).

The response of any cultivar depends on genetic potentiality and its interaction with environmental conditions of the domain, necessitating the selection of a suitable cultivar. As such, the genotypical comparisons of the three hybrids tried in the present study are as follows.

### **5.2.1 Growth Characters**

Plant height increased with increase in age of the crop irrespective of the hybrids. No significant of plant heights difference between the three hybrids at 30, 60 DAS. But at harvest there is significant difference between the three hybrids. Among the three hybrids studied, BH 40625 recorded maximum plant height at all the stages which might be due to genetic disparity. However the plant heights of

three hybrids were on par with each other. Similar varietal difference in respect of plant height of maize was reported by Shanti *et al.* (1997) and Sanjeev Malaiya *et al.*, (2004)

Plant height increased with an increase in age of the crop upto maturity (Table 3 and fig.3). The results on plant height revealed that, the rate of increase in plant height was greater up to tasseling stage and thereafter the increase was less.

The number of leaves produced per plant did not vary much with different hybrids and nitrogen level treatments (Table 4). The number of leaves put forth per plant reached to a maximum by 60 DAS and thereafter the leaf number declined with advancement of growth due to senescence of the lower leaves. Observations made at different crop growth periods indicated that there is no significant difference between the treatments with increase in nitrogen level. At different growth periods, application of higher doses of nitrogen favoured the crop to put forth more number of leaves per plant as the nitrogen is the primary absorber of light energy needed for photo synthesis and the integral part of chlorophyll which imparts green colour to plants. At harvest stage the number of green leaves were less, and that might be due to phosphorus which was associated with early maturity of the crop and further senescence of the lower leaves. Similar findings were reported by Bangarwa *et al.* (1989), Selvaraju and Iruthaya raju (1994) and Singh *et al.* (2003).

In general, there was a progressive increase in leaf area index of a plant with advancing age of the crop up to 60 DAS in all the hybrids, beyond which later gradual reduction was observed due to senescence of foliage (Table 5 and fig.4). BH 40625 recorded significantly higher leaf area index at all the stages of crop growth compared to other cultivars. This was due to more number of leaves plant<sup>-1</sup> and large sized leaves. Leaf area index was the lowest with hybrid BH 1576, inspite of having higher plant height, which might be due to smaller leaf size. Observations made at different crop growth periods indicated that there is significant difference between the treatments with increase in nitrogen level. At different growth periods, application of higher doses of nitrogen favoured the crop to put forth more leaf area .Variation in LAI of maize cultivars has been reported by Ashok Kumar (1985), Afzal Begum (1994), Sreedhar *et al.* (1993) and Shanti *et al.* (1997). Increase in LAI with increase in nitrogen level was reported by Sanjeev Kumar and Bangarwa (1997) (Appendix -4).

Progressive increase in the dry matter accumulation of plants with advance in age of the crop was observed (Table 6 and fig.5) (Appendix -5). Among three cultivars, BH 40625 recorded maximum and significantly higher dry matter production at 30, 60 DAS and at harvest compared to Super 900 M and BH 1576. This might be due to its genetic potential and well developed large sized stalks and higher leaf area index which accumulates higher quantity of photosynthates, contributing to higher dry matter accrual. Similar disparity of dry matter

production among cultivars of maize was noticed by Sreedhar *et al.* (1993), Shanti *et al.* (1997) and Tiwana *et al.*, (1999).

With respect to days to 50 per cent silking, BH 1576 required more number of days than the other two hybrids (Table 7). However the three hybrids were on par with each other varietal difference with respect to days taken to 50 per cent flowering was in maize reported by Halemani *et al.* (1980) and Sreedhar *et al.* (1993).

On the other hand Days to physiological maturity was not significantly influenced by varietal treatments.

### **5.2.2 Yield Attributes**

The yield attributes such as cob girth, number of grain cob<sup>-1</sup>, number of grain rows cob<sup>-1</sup> Harvest Index and shelling percentage produced by three hybrids namely Super 900 m, BH 1576 and BH 40625 were not significant While the test weight was found highest with cultivar BH 40625. This might be due to genetic superiority of hybrid BH 40625 over other two hybrids BH 1576 and Super 900 M, with respect to higher leaf area index or assimilatory surface leading to higher dry matter production coupled with effective translocation and distribution of photosynthates from source to sink. Sreedhar *et al.*, (1993) also reported higher yield components with hybrid DHM 103 than composite EVB21. Similar trend was also noticed by Reddy *et al.* (1987), and Shanti *et al.* (1997).

### 5.2.3 Yield

Different cultivars of maize having different genetic potentiality are known to respond differently to similar management practices and exactly the same was also seen in the present experiment.

BH 40625 recorded significantly higher grain yield ( $6700 \text{ kg ha}^{-1}$ ) than Super 900 M ( $6557 \text{ kg ha}^{-1}$ ), and BH 1576 ( $6456 \text{ kg ha}^{-1}$ ) (table 9 and fig.6) The yield increase recorded with BH 40625 was on par with Super 900 M and BH 1576. But compared to Super 900 M and BH 1576 the hybrid BH 40625 produced more yield. This could be ascribed to higher cob weight, seed weight  $\text{cob}^{-1}$  and shelling percentage obtained with BH 40625. The superiority of hybrid BH 40625 over Super 900 M and BH 1576 with respect to yield components and yield may be due to its genetic potentiality to utilize and translocate photosynthates from source to sink and their better adoptability to this agroclimatic conditions. Similar trend was also noticed by Manish kumar *et al.*, (2001).

Highest harvest index was noticed with Super 900 m, which was however, on par with BH 1576 and BH 40625. The lowest value of harvest index was recorded with BH 40625. This might be due to difference in partitioning efficiency of photosynthates from source to sink. The variation in harvest index among maize cultivars was also reported by Sreedhar *et al.* (1993).

#### **5.2.4 Protein content of maize grain**

Different cultivars of maize having different genetic potentiality are known to respond differently. The protein content of grain varied with the three hybrids (table 10). The variation in protein content of maize grain was also reported by Shanti *et al.* (1997).

### **5.3 INFLUENCE OF NITROGEN LEVELS ON THE PERFORMANCE OF MAIZE**

#### **5.3.1 Growth Characters**

Among nitrogen levels, 300 kg ha<sup>-1</sup> dose recorded maximum height, at all the stages of crop growth. This is due to application of higher doses of nitrogen resulted in consistent availability and better uptake of the nutrients and thereby increase in the assimilate synthesis with plentiful supply of nutrients, plant growth would have improved resulting in taller plants. Consequently, the apical meristematic activity was enhanced. Similar findings were reported by, Shanti *et al.* (1997), Thakur and Vinod Sharma (1999) and Muhammad *et al* (2000).

The number of leaves produced per plant did not vary much with different nitrogen levels (Table 4). The number of leaves put forth per plant reached to a maximum by 60 DAS and thereafter the leaf number declined with advancement of growth due to senescence of the lower leaves. Observations made at different crop growth periods indicated that there is no significant difference between the

treatments with increase in nitrogen level. At different growth periods, application of higher doses of nitrogen favoured the crop to put forth more number of leaves per plant as the nitrogen is the primary absorber of light energy needed for photo synthesis and the integral part of chlorophyll which imparts green colour to plants. At harvest stage the number green leaves were less, and that might be due to phosphorus which was associated with early maturity of the crop and further senescence of the lower leaves. Similar findings were reported by Bangarwa *et al.* (1989), Selvaraju and Iruthaya raju (1994) and Singh *et al.* (2003).

In general, there was a progressive increase in leaf area index of a plant with advancing age of the crop up to 60 DAS in all the hybrids, beyond which later gradual reduction was observed due to senescence of foliage. Leaf area index was significantly influenced by different nitrogen levels (Table 5 and fig.4)). The highest leaf area index was associated with 300 kg ha<sup>-1</sup> recommended dose of nitrogen while the lowest LAI was obtained with 150 kg ha<sup>-1</sup> nitrogen application. Increase in LAI with increase in nitrogen levels was evidently due to favourable effect of nitrogen on cell enlargement resulting in larger leaves. Greater LAI may be due to improved growth with increased supply of nutrients particularly N at the critical physiological stages viz., knee high stage (beginning of grand vegetative growth) and tasseling stage (stage of maximum uptake of nutrients). The present findings are in confirmity with those of Naresh Kumar and Singh (2001) and Raja (2001).

At all the crop growth stages, increasing the nitrogen levels from 150 to 300 kg ha<sup>-1</sup> resulted in increased dry matter production (table 6 and fig.5) The highest dry matter production of maize was recorded with 300 kg ha<sup>-1</sup> recommended dose of nitrogen while it was the lowest with 150 kg ha<sup>-1</sup> nitrogen application. Adequate supply of nitrogen might have helped the maize plants to increase their growth and plant height due to the favourable effect on cell enlargement and production of larger leaves. These effects ultimately might have resulted in a higher photosynthetic efficiency and there by could have accumulated higher quantity of dry matter. Enhanced dry matter production with adequate supply of nitrogen evidenced in this investigation corroborates the findings of Shanti *et al.* (1997), Vadivel *et al.* (1999) and Raja (2001).

Higher level of nitrogen resulted in early silking and the maize crop that received 300 kg ha<sup>-1</sup> of nitrogen took less number of days to attain 50 per cent silking while the crop that received 150 kg ha<sup>-1</sup> had shown delayed 50 per cent flowering (Table 7). Adequate supply of nitrogen might have helped in higher vegetative growth leading to early reproductive phase resulting in early silking. Similar results of early silking with increased nitrogen levels were also reported by Kamta Prasad and Prem Singh (1990), Paradkar and Sharma (1993) and Shanti *et al.* (1997).

On the other hand Days to physiological maturity was not significantly influenced by nitrogen level treatments.

### 5.3.2 Yield Attributes

Each successive increased level of nitrogen resulted in a corresponding increase in length and girth of the cob which were found to be highest with 300 kg ha<sup>-1</sup> recommended dose of nitrogen while they were lowest with 150 kg ha<sup>-1</sup> nitrogen application. Better crop growth and early tasselling and silking might have resulted in better translocation of photosynthates from source to sink resulting in bigger cob size. These results are in confirmity with the findings of Shanti *et al.* (1997), Singh *et al.* (2000) and Vadivel *et al.* (2001).

Yield attributes like number of grains per cob, weight of grains per cob, shelling percentage and test weight were found to be highest with 300 kg ha<sup>-1</sup> recommended dose of nitrogen while least values of these characters were recorded with 150 kg ha<sup>-1</sup> nitrogen application. Greater production of photosynthates and their efficient translocation to the reproductive parts due to the supply of adequate nitrogen levels might be responsible for these beneficial effects on yield attributes . These results are in agreement with the findings of Thakur *et al.* (1997), Tyagi *et al.* (1998) and Rameshwar Singh and Totawat (2002).

### 5.3.3 Yield

Increase in nitrogen level from 150 to 300 kg ha<sup>-1</sup> resulted in progressive and linear increase in yield and the highest seed yield of maize was recorded with 300 kg ha<sup>-1</sup> recommended dose of nitrogen while the lowest seed yield was recorded with 150 kg ha<sup>-1</sup> nitrogen application (table 9 and fig.6) . The beneficial

effect of nitrogen nutrition, which resulted in better growth and yield attributes, was reflected in higher seed yield of maize with higher dose of nitrogen (Table 4.8) .These results corroborate the findings of Krishnamurthy *et al.* (1974), Paradkar and Sharma (1993), Kaul *et al.* (1994), Vadivel *et al.* (1999) and Rameshwar Singh and Totawat (2002).

The highest stover yield (Table 9 and fig.7) was recorded with 300 kg ha<sup>-1</sup> of nitrogen while it was lowest with 150 kg ha<sup>-1</sup> nitrogen application. This increased stover yield with increase in nitrogen levels could be attributed to significant increase in the plant height accompanied by a larger leaf area index both of which were reflected in a higher dry matter production. These results are in confirmity with the findings of Shanti *et al.* (1997), Vadivel *et al.* (1999) and Raja (2001).

Highest harvest index was noticed with 300 kg ha<sup>-1</sup> of nitrogen. The lowest value of harvest index was recorded with 150 kg ha<sup>-1</sup> recommended dose of nitrogen. Similar results of Harvest index with increased nitrogen levels were also reported by Shanti *et al.* (1997).

#### **5.3.4 Protein content of maize grain**

Application of adequate nitrogen not only increased the yield but also improved the quality of grain as evident from the higher protein content in 200, 250 and 300 kg N ha<sup>-1</sup> treatment (table 10 and fig.10). This is logical since N

forms the principle constituent of protein molecule. Similar results of protein content with increased nitrogen levels were also reported by Shanti *et al.* (1997).

### **5.3.6 Post-harvest soil nutrient status**

Post harvest soil available nitrogen, increased with increasing nitrogen levels (table 11). Increase in available nitrogen in soil with increasing level of nitrogen application might be due to an increase in mineralizable nitrogen. Decrease in available phosphorus in soil with an increase in nitrogen level might be attributed to an increased crop growth. This might have led to more root exudates and ultimately solubilized more soil phosphorus, thus registering decreased soil available phosphorus. Decrease in available potassium with successive increased level of nitrogen might be due to the increase in the concentration of  $\text{NH}_4^{++}$  ion in the soil solution which would have replaced  $\text{K}^+$  from the clay complex as reported by Krishnan and Lourduraj (1997).

### **5.3.7 Nutrient uptake of maize**

Uptake of nitrogen, phosphorus and potassium by maize crop increased significantly with increased nutrient levels (table 12). This was mainly due to the influence of applied nutrients on root development and thereby resulting in efficient absorption of mineral nutrients coupled with higher dry matter production under higher nutrient levels. These results are in confirmity with the findings of Dey and Sharma (1996).

#### 5.4 INTERACTION EFFECT OF VARIETIES AND NITROGEN LEVELS

Significant interaction was found between varieties and nitrogen levels, with respect to leaf area index (30, 60 DAS and at harvest), Harvest index, protein content of grain, available N,P in soil and nutrient uptake of N,P and K.

BH 40625 with 300 kg ha<sup>-1</sup> had significantly higher leaf area index over other treatments at all stages of crop growth (Appendix 2,3,4). Application of adequate N not only influenced the leaf area index but also increased the yield. These results are in conformity with the findings of Shanti *et al.* (1997).

The hybrid BH 40625 with 300 kg ha<sup>-1</sup> recorded the highest harvest index compared to other combinations, which might be due to efficient partitioning of photosynthates from source to sink. These results are in conformity with the findings of Shanti *et al.* (1997).

BH 40625 with 300 kg ha<sup>-1</sup> had significantly higher protein content over other treatments. Application of adequate N not only increased the yield but also improved the quality of grain. These results are in conformity with the findings of Manish kumar *et al.*, (2001).

Post-harvest soil fertility status (available nitrogen, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O) did not deteriorate with any of the combinations of varied irrigation and nutrient levels. Varieties in combination with the highest level of nutrient supply have resulted in the highest post-harvest soil fertility status.

In spite of the fact that nutrient uptake was higher with combination of BH 40625 with 300 kg ha<sup>-1</sup>, still larger quantities of nutrients were left in the soil (Appendix -6, 7). This was due to application of higher dose of nutrients, which could meet the maximum requirement by the crop and the nutrients over and above the crop requirement were left over in the soil, resulting in higher level of post harvest soil fertility status.

Nutrient uptake in straw showed that N, P and K uptake followed the yield level trend and was maximum in BH 40625 and Super 900 M (Appendix -8, 9, 10). The N, P and K uptake was lowest in BH 1576. The fertility levels significantly influenced the nutrient uptake. Application of 300 kg N ha<sup>-1</sup> resulted in the highest uptake followed by 250 and 200 kg N ha<sup>-1</sup>. Similar trend was also noticed by Anil Kumar *et al.* (2002).

## **5.5 Economics**

Higher gross returns, net returns and B:C ratio were realized with BH 40625 compared to other cultivars, because of higher grain yield and stover yield obtained with BH 40625. Sreedhar *et al.* (1993) have also reported this type of disparity among maize cultivars

Higher gross returns, net returns and B:C ratio were observed with 250, 300 kg N ha<sup>-1</sup> compared to other treatments, because of higher grain yield (Appendix - 11). However the treatments were on par with each other. Similar results of

economics with increased nitrogen levels were also reported by Thakur and Vinod Sharma (1999).

## CHAPTER VI

### SUMMARY

A field experiment was conducted during *rabi* 2008-09 on sandy loam soils of College farm, College of Agriculture, Rajendranagar, Hyderabad (Acharya N.G.Ranga Agricultural University, Andhra Pradesh) to study the “Evaluation of genotypes and nitrogen levels for yield maximization in *rabi* maize (*Zea mays* L.)”. The experiment was laid out in a split plot design and replicated thrice. Three hybrids, BH 1576, Super 900 M and BH 40625 and as main plot treatments and four levels of nitrogen (150,200,250 and 300 kg N ha<sup>-1</sup>) as sub plot treatments in split plot design with three replications.

Observations pertaining to initial and final plant stand, plant height, dry matter accumulation, number of leaves and phenological events at different crop growth phases were made. Similarly, yield attributes viz., ear length, girth, 100 seed weight, number of grain rows per cob, number of grain per cob, grain yield, stover yield, nutrient uptake and nutrient status of the soil after crop harvest and economics were assessed.

The initial and final plant stand of maize (Table 1) was not significantly influenced by either hybrids or different fertilizer treatments. Hence the differences observed in various treatments were not due to population variations.

Plant height, leaf area index, dry matter production, yield components and yield differed among the cultivars due to genetic variability.

The hybrid BH 40625 recorded the highest plant height which was superior to BH 1576 and Super 900M. Significantly lower plant height was observed with BH 1576.

Leaf area index and dry matter production were influenced by different hybrids. Highest leaf area index and total dry matter production was recorded with the hybrid BH 40625 and the lowest was with BH 1576.

Genetic nature of cultivars exerts appreciable influence on number of days taken to tasseling and silking. The earliest flowering was observed in short duration hybrid BH 40625 and delayed flowering in BH 1576.

The highest number of seed rows  $\text{cob}^{-1}$  and number of seeds  $\text{cob}^{-1}$  was not significant among hybrids but length of the cob, and shelling percentage was highest with BH 40625. However the highest test weight was recorded with hybrid BH 40625.

Seed yield, stover yield and harvest index was also not significantly influenced by different hybrids. However the highest seed yield, stover yield and harvest index was recorded with BH 40625 which was on par with other two hybrids.

The highest gross returns, net returns and B:C ratio was obtained with BH 40625 which was on par with other hybrids.

Increasing nitrogen levels increased the growth parameters (plant height, leaf area index, dry matter production) and earliness in number of days to 50 per cent tasselling and silking. Further, each of the successive incremental dose of nitrogen increased the yield attributes (length and girth of the cob, number of grain rows cob, number of grains per cob, and test weight), yield (seed and stover), post harvest soil nutrient status (available nitrogen, available phosphorus ( $P_2O_5$ ) contents), grain quality parameters (protein) and economics. The highest dose of  $300 \text{ kg ha}^{-1}$  recommended dose of nitrogen resulted in significantly superior values of all these characters. While  $150 \text{ kg ha}^{-1}$  recommended dose of nitrogen accounted for the low values of all the above parameters.

Interaction effect of varieties and nitrogen levels was found significant in case of leaf area index at 30, 60 DAS and at harvest , protein content, available nitrogen and phosphorus ( $P_2O_5$ ) contents in soil, nutrient uptake of nitrogen ,phosphorus ( $P_2O_5$ ) potassium ( $K_2O$ ) contents and benefit cost ratio. The highest values of almost all the growth parameters, yield attributes and yield were obtained with hybrid BH 40625 along with  $300 \text{ kg ha}^{-1}$  recommended dose of nitrogen while the lowest values were observed with BH 1576 along with  $150 \text{ kg ha}^{-1}$  nitrogen application. In case of post harvest soil available nitrogen and phosphorus ( $P_2O_5$ ) contents BH 1576 along with  $300 \text{ kg ha}^{-1}$  recommended dose of nitrogen resulted in the highest values. The nutrient uptake of nitrogen, phosphorus ( $P_2O_5$ ) potassium ( $K_2O$ ) contents BH 40625 long with  $300 \text{ kg ha}^{-1}$

recommended dose of nitrogen resulted in the highest values. The benefit: cost ratio was highest with BH 40625 along with 300 kg ha<sup>-1</sup> recommended dose of nitrogen.

The following conclusions could be drawn from the present investigation.

- All the growth parameters viz., plant height and dry matter accumulation and LAI increased progressively with increase in nitrogen dose from 150-300 kg N ha<sup>-1</sup>.
- All the hybrids tested i.e. BH 40625, BH 1576 and Super 900 M performed almost alike.
- Yield attributes like length and girth of the cob, number of grain rows cob, number of grains per cob, and test weight were increased significantly with each higher level of nitrogen up to 300 kg ha<sup>-1</sup>.
- Higher Benefit cost ratio can be obtained with a nitrogen dose of 200 kg ha<sup>-1</sup>.
- For achieving higher grain yield of 6.5-7.0 t ha<sup>-1</sup> we must select a good hybrid and go for a higher nitrogen dose of 200-250 kg N ha<sup>-1</sup> in addition to regular package of practices given to the crop.



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## Appendix -1

### Weekly meteorological data during crop growth period 2008-09

WEEK NO.	PERIOD	TEMPERATURE (°C)		R.H. (%)		RAIN-FALL (mm)	RAINY DAYS	SUN-SHINE (hrs.)	WIND SPEED (km/hr)	EVAPO-RATION (mm)	MEAN TEMP. (°C)
		MAX.	MIN.	I	II						
44	29-04 NOV	31.8	13.9	69	31	0.0	0	9.6	2.5	6.5	22.8
45	05-11	30.6	14.0	81	59	0.0	0	9.1	2.4	6.7	22.3
46	12-18	28.6	17.6	88	61	1.0	0	5.2	4.5	5.6	23.1
47	19-25	30.3	19.0	91	54	0.0	0	7.0	3.2	5.5	24.7
48	26-02 DEC	26.9	18.4	88	64	11.6	2	3.8	4.5	4.5	22.6
49	03-09	29.6	14.0	90	36	0.0	0	8.6	2.5	5.7	21.8
50	10-16	29.9	15.8	93	41	0.0	0	8.3	2.6	5.2	22.8
51	17-23	29.3	13.4	88	36	0.0	0	8.4	2.9	5.6	21.4
52	24-31	29.7	12.7	85	32	0.0	0	8.9	1.9	5.1	21.2
1	01-07 JAN	28.6	14.0	90	43	0.0	0	8.6	2.5	4.6	21.3
2	08-14	28.4	16.1	89	43	0.0	0	7.7	4.4	4.5	22.2
3	15-21	29.3	13.2	85	35	0.0	0	8.7	3.3	5.3	21.3
4	22-28	32.6	12.0	83	20	0.0	0	9.8	2.7	5.6	22.3
5	29-04 FEB	34.6	15.4	83	23	0.0	0	9.8	2.8	6.1	25.0
6	05-11	32.8	17.2	81	31	0.0	0	9.1	3.4	5.8	25.0
7	12-18	32.9	16.8	81	32	0.0	0	9.3	3.1	6.1	24.9
8	19-25	34.4	16.6	77	24	0.0	0	9.9	3.7	6.4	25.5
9	26-04 MAR	32.7	14.3	57	14	0.0	0	8.9	2.1	6.5	23.5
10	05-11	36.9	17.2	67	21	0.0	0	8.9	3.5	7.3	27.1
11	12-18	34.3	17.9	66	22	0.0	0	7.0	3.3	6.5	26.1
12	19-25	35.4	20.1	68	25	0.0	0	6.1	3.8	7.2	27.7
13	26-01 APR	37.0	20.2	71	24	0.0	0	8.5	3.0	7.4	28.6
14	02-08	38.8	21.9	68	24	10.4	1	8.3	4.1	7.5	30.4
	MEAN	32.0	16.2	79.9	34.5	1.0	0.1	8.2	3.2	6.0	24.1