# Effect of Plant Population and Fertility Levels on Yield and Quality of Baby Corn (*Zea mays* L.)

**cch dku ¼*th;k et* ,y-½ dh mit ,o x.koÙkk ij ikni l[;k o mojrk Lrjk dk iHkko**

Thesis

Submitted to the

**Maharana Pratap University of Agriculture and Technology, Udaipur**

In partial fulfillment of the requirement for

the degree of

**Master of Science in Agriculture**

**(*Agronomy*)**

**By**

**RIDHI CHAUDHARY**

**2006**

**Maharana Pratap University of Agriculture and Technology**
**Rajasthan College of Agriculture, Udaipur**

## CERTIFICATE - I

Date : / / 2006

This is to certify that **Miss Ridhi Chaudhary** has successfully completed the Comprehensive Examination held on 15$^{th}$ April, 2006 as required under the regulations for the degree of **Master of Science in Agriculture.**

**(Dr. M.K. Porwal)**
Prof. & Head
Department of Agronomy
Rajasthan College of Agriculture
Udaipur (Raj.)

# Maharana Pratap University of Agriculture and Technology
# Rajasthan College of Agriculture, Udaipur

## CERTIFICATE - II

Date : / /2006

This is to certify that the thesis entitled **"Effect of Plant Population and Fertility Levels on Yield and Quality of Baby Corn (*Zea mays* L.)",** submitted for the degree of **Master of Science in Agriculture** in the subject of **Agronomy,** embodies bonafide research work carried out by **Miss Ridhi Chaudhary** under my guidance and supervision and that no part of this thesis has been submitted for any other degree. The assistance and help received during the course of investigation have been fully acknowledged. The draft of this thesis was also approved by the advisory committee on 20$^{th}$ June, 2006.

**(Dr. M.K. Porwal)**
Prof. & Head
Department of Agronomy
Rajasthan College of Agriculture,
MPUAT, Udaipur

**(Dr. M.K. Porwal)**
Major Advisor

**(Dr. H.C.L. Gupta)**
Dean
Rajasthan College of Agriculture,
MPUAT, Udaipur

# Maharana Pratap University of Agriculture and Technology
# Rajasthan College of Agriculture, Udaipur

## CERTIFICATE - III

Date : / /2006

This is to certify that the thesis entitled **"Effect of Plant Population and Fertility Levels on Yield and Quality of Baby Corn (*Zea mays* L.)",** submitted by **Miss Ridhi Chaudhary** to the Maharana Pratap University of Agriculture and Technology, Udaipur in partial fulfillment of the requirements for the degree of **Master of Science in Agriculture** in the subject of **Agronomy** after recommendation by the external examiner was defended by the candidate before the following members of the examination committee. The performance of the candidate in the oral examination on his thesis has been found satisfactory, we therefore, recommend that the thesis be approved.

**(Dr. M.K. Porwal)**
Major Advisor

**(Dr. Dilip Singh)**
Advisor

**(Dr. Sudha Mathur)**
Advisor

**(Dr. U.S. Sharma)**
DRI Nominee

**(Dr. M.K. Porwal)**
Prof. & Head
Department of Agronomy
RCA, Udaipur

**(Dr. H.C.L. Gupta)**
Dean
Rajasthan College of Agriculture,
Udaipur

**Approved**

**(Dr. G.C. Nanawati)**
Director Resident Instructions
Maharana Pratap University of Agriculture and Technology,
Udaipur

**Maharana Pratap University of Agriculture and Technology**
**Rajasthan College of Agriculture, Udaipur**

## CERTIFICATE - IV

Date : / /2006

This is to certify that **Miss Ridhi Chaudhary,** student of Master of Science in Agriculture, Department of Agronomy, Rajasthan College of Agriculture, Udaipur has made all the corrections/modifications in the thesis entitled **"Effect of Plant Population and Fertility Levels on Yield and Quality of Baby Corn (*Zea mays* L.)",** which were suggested by the external examiner and the advisory committee in the oral examination held on ........................... The final copies of the thesis duly bound and corrected were submitted on ............................, are enclosed herewith for approval.

**(Dr. M.K. Porwal)**
Major Advisor

Enclose : One original and three copies of bound thesis forwarded to the Director, Resident Instructions, Maharana Pratap University of Agriculture and Technology, Udaipur through the Dean, Rajasthan College of Agriculture, Udaipur.

**(Dr. H.C.L. Gupta)**
Dean
Rajasthan College of Agriculture,
MPUAT, Udaipur

**(Dr. M.K. Porwal)**
Prof. & Head
Department of Agronomy
Rajasthan College of Agriculture,
MPUAT, Udaipur

# Effect of Plant Population and Fertility Levels on Yield and Quality of Baby corn (*Zea mays* L.)

**Ridhi Chaudhary**[*] **Dr. M.K. Porwal**[**]
Research Scholar Major Advisor

ABSTRACT

A field experiment entitled "Effect of Plant Population and Fertility Levels on Yield and Quality of Baby Corn (*Zea mays* L.)" was conducted during *kharif* 2005 at the instructional from, Department of Agronomy, Rajasthan College of Agriculture, Udaipur. The objectives were to study effect of plant population and balanced mineral nutrition on productivity and quality of Baby corn. The experiment consisted 16 treatment combinations comprising four plant population (83 K, 111 K, 166 K and 333 K plants ha$^{-1}$) and four fertility levels (60+30, 90+35, 120+40 and 180+45 kg N+ $P_2O_5$ ha$^{-1}$). These treatments were replicated three times in a randomized block design.

Amongst plant population, maintenance of 83 K plants ha$^{-1}$ accumulated highest dry matter at successive growth stages compared to 111 K, 166 K and 333 K plants ha$^{-1}$. Plant height was increased as plant density increased from 83 K to 333 K plants ha$^{-1}$. Crop under influence of 333 K plants ha$^{-1}$ attained highest LAI compared to 83 K, 111 K and 166 K plants ha$^{-1}$. Stem diameter was found to be highest at 83 K plants ha$^{-1}$ compared to 166 K and 333 K plants ha$^{-1}$ but closely followed by 111 K plants ha$^{-1}$. Number of ears plant$^{-1}$ was highest at 83 K plants ha$^{-1}$ where as 333 K plants ha$^{-1}$ gave highest ear length. Ear girth decreased with increase plant population from 83 K plants ha$^{-1}$ to 333 K plants ha$^{-1}$. Both fresh and dry weight of ears was highest at 83 K plants ha$^{-1}$ and decreased with increased plant population up to 333 K plants ha$^{-1}$. Number of barren plants were highest at higher plant densities (333 K plants ha$^{-1}$). Cob weight with husk was also highest at higher plant population of 333 K plants ha$^{-1}$. Highest Baby corn, green fodder and biological yield were recorded at 166 K plants ha$^{-1}$ closely followed by 333 K plants ha$^{-1}$. Moisture content of ears was high at higher densities where as protein content and carbohydrate content of ears was higher at 166 K plants ha$^{-1}$. Ascorbic acid content increased up to 166 K plants ha$^{-1}$

[*] PG Scholar, Department of Agronomy, RCA, Udaipur.
[**] Professor & Head, Department of Agronomy, RCA, Udaipur.

further increase in plant population did not increase ascorbic acid content of ears. Crude protein content of fodder was highest at 333 K plants $ha^{-1}$ N and P content of ears and fodder were recorded to be highest at 166 K plants $ha^{-1}$. The highest net return (Rs.25400 $ha^{-1}$) and B:C (2.00) were recorded under plant density of 166 K plants $ha^{-1}$ closely followed by 333 K plants $ha^{-1}$ while it was least under 83 K plants $ha^{-1}$ [net returns (Rs.14540 $ha^{-1}$ ) and B : C (2.00) ].

Increasing level of fertilizer up to 180 kg N and 45 kg $P_2O_5$ $ha^{-1}$ significantly improved plant height, dry matter accumulation at successive growth stages and stem diameter. Yield attributing parameters were increased significantly up to 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$. Number of barren plant decreased with increasing fertility levels. Cob weight with husk increased significantly up to 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$. Baby corn, green fodder and biological yield were significantly higher under application of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$over 60 kg and 30 kg $P_2O_5$ $ha^{-1}$. Further increase in fertilizer did not record perceptible variation. Amongst quality parameter highest moisture and protein were recorded with application of 120 kg N and 40 kg $P_2O_5$ $ha^{-1}$ where as ascorbic acidm crude protein of fodder were highest under 180 kg N and 45 kg $P_2O_5$ $ha^{-1}$. Highest net return was recorded under 120 kg N and 40 kg $P_2O_5$ $ha^{-1}$. However, the most economic dose was 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ as it recorded highest B:C (1.73).

# 1 INTRODUCTION

In Indian agriculture, the maize crop assumes a special significance on account of its utilization as food, feed and fodder besides several industrial uses.

Maize ranks after rice and wheat as the third most important crop in the world. In India, among cereals to it ranks 5$^{th}$ in area and 3$^{rd}$ in production. In Rajasthan, maize occupies about 11,107,12 ha area in Mewar and Vagad region. Maize is the refer known as queen of coarse cereals. Specialty corns *viz*. Sweet corn, Pop corn, Baby corn, high oil corn etc. assume tremendous market potential not only in India but in international market as well. These speciality corns with their high market value are perfectly suitable to periurban agriculture either as sole crop or as an intercrop with other remunerative crops like cut flowers, vegetables and spices. Thus speciality corn promises higher income to maize growers. Hence, increasing attention is now being paid to explore the potential of specialty corn along with normal corn in India. In future, more area would be put under speciality corn.

Baby corn is not a separate type of corn like sweet corn or pop corn and that any corn type can be used as Baby corn. Baby corn is the ear of maize (*Zea mays* L.) harvested young, especially when the silk have either not emerged or just emerged, and no fertilization has taken place or we can say the shank with unpollinated silk is Baby corn. The economic product is harvested just after silk emerge (1-2 cm long).

Baby corn is a popular vegetable in USA, Europe and South-east Asia. The demand for Baby corn is rapidly increasing in urban areas in India. Baby corn has immense potential as a salad and as cooked vegetable. It is used as an ingredient in chopsuey (Chinese dish), soups, deep fried Baby corn with meat, rice and other vegetables. Baby corn is highly nutritive (Paroda, 1994). Nutritive value of Baby corn per 100 g of edible portion is, 89.10 per cent moisture content, 8.20 g carbohydrates, 1.90 g protein, 28 g calcium, 86 mg phosphorus, 0.10 mg iron, 0.50 mg thiamine, 0.08 mg riboflavin, 11 g ascorbic acid (Thakur, 2000). Importantly, its nutritional value is comparable to popular vegetables like cauliflower, cabbage, tomato, eggplant and cucumber. Its by-products such as tassel young husk, silk and green stalks provide good cattle feed, which is also very nutritious.

In order to achieve higher ear yields, maintenance of stand density is the most important factor. A spatial arrangement of plant governs the shape and size of the leaf area per plant, which in turn influences efficient interception of radiant energy and proliferation and growth of roots and their activity. Maximum yield can be expected only when plant population allows individual plant to achieve their maximum inherent potential. Thus, there is need to workout an optimum population density by adjusting inter and intra row spacing in relation to other agronomic factors.

Among other agronomic factors adequate fertilization is considered to be one of the most important in scientific crop production. Nitrogen is indispensable for increasing crop production as it being a constituent of protoplasm and chlorophyll and is associated with the activity of every living cell. It is an essential constituent of protein and is present in many other compounds of physiological importance in plant metabolites such as nucleotides, phosphatides, alkaloids, enzymes, hormones and vitamins etc. Further maize is a $C_4$ crop having best physiological efficiency. Thus, nitrogen will help in boosting higher photosynthetic efficiency and finally of maize yield. Phosphorous is also a nutrient of paramount importance for energy transfer in living cells by means of higher energy phosphate bond of ATP (Tisdale *et al*., 1985). It is an important structural component of carbohydrates, fatty acids, nucleic acids, phytin, phospholipids, enzymes and other essential intermediate compounds. It also affects protein content of maize grain. Therefore, there is need to workout optimum plant density and combination of nitrogen and phosphorus fertilizers for Baby corn under prevailing agro-climatic conditions of zone IVa of Rajasthan.

Considering the above facts and paucity of research findings, the present investigation entitled "Effect of Plant Population and Fertility Levels on Yield and Quality of Baby Corn (*Zea mays* L.)" have been planed with following objectives:

- To study effect of plant population on the productivity and quality characters of Baby corn.
- To work out the optimum fertilizer doses for Baby corn.
- To find out relative economics.

# 2 REVIEW OF LITERATURE

A brief review related to research work done on "Effect of Plant Population and Fertility Levels on Yield and Quality of Baby Corn (*Zea mays* L.)" is presented in this chapter. Since the work done on the plant population and fertilizer levels on Baby corn is very meager, therefore wherever found necessary pertinent research finding of other quality corn *viz.* popcorn, sweet corn and maize has been incorporated.

## 2.1 EFFECT OF PLANT POPULATION

### 2.1.1 Growth Characters

At Almora (Uttaranchal), Pandey (1995) reported that days to silking in Baby corn did not differ significantly under the influence of different plant populations *viz.* 111 K, 133 K and 166 K plants $ha^{-1}$. Similarly, at Jashipur (Orissa), Sahoo (1995) observed that Baby corn under influence of different plant population failed to influence days to harvest initiation. Patil (1997) reported that two Baby corn varieties (Baby corn 1 and Baby Corn 2) did not differ significantly in terms of plant height. Similarly, at Almora (Uttaranchal), Pandey (1997) did not recorded significant variation in days to silking under influence of various plant densities. Thakur *et al.* (1997) observed that with increasing plant population, plant height, number of functional leaves, dry matter production and harvest period were decreased significantly, however, days to harvest initiation increased significantly with increase in plant population. Sharma (2001) observed that maintenance of 166 K plants $ha^{-1}$ at initial stage recorded highest plant population at harvest compared to 111 K and 83 K plants $ha^{-1}$. Pandey *et al.* (2002) at Almora (Uttaranchal) reported that with increased plant population from 111 K to 166 K plants $ha^{-1}$ barrenness and harvest initiation days were increased significantly, however, duration was reduced by two days. Further, plant height remained unaffected under influence of different plant densities. At Chhindwara (M.P.), Paradkar (2004) reported that plant height of Baby corn increased significantly with increase in plant densities. However, plant densities could not influence days to 50% silking. At Srinagar (J&K), various plant densities *viz.* 83 K, 111 K and 116 K plants $ha^{-1}$ failed to record perceptible variation in plant height and days to 50% silking. However, at harvest maintenance of 116 K plants $ha^{-1}$ recorded significantly higher plant population over two other densities (Allie, 2005). Similarly at Chhindwara (M.P.), Paradkar (2005) recorded variation in plant population which was significant under different plant densities, they further reported increased plant height under 83 K plants $ha^{-1}$ compared to 111 K and 116 K plants $ha^{-1}$. However, days to 50% silking did not show perceptible variation under influence of different plant densities.

- **2.1.2 Yield Attributes and Yield**
- At Almora (Uttaranchal), Pandey (1995) observed maximum cob length, diameter of cobs, Baby corn yield and green fodder yield under maintenance of 166 K plants $ha^{-1}$ which was found significantly superior over 111 K plants $ha^{-1}$, however, found at par with 133 K plants $ha^{-1}$. Whereas Sahoo (1995) at Jashipur (Orissa) recorded highest length, weight and girth of Baby corn under 83 K plants $ha^{-1}$ which was found at par with 110 K plants $ha^{-1}$ but proved significantly lower compared to 128 K plants $ha^{-1}$. Further, per hectare maximum highest barren plants were recorded under highest population (128 K plants $ha^{-1}$) consequently decreased number of cobs $ha^{-1}$ compared to lower plant population (83 K plants $ha^{-1}$). But at Arbhavi (Karnataka), Patil (1997) reported that 166 K plants $ha^{-1}$ improved cob length, number of Baby corn, green fodder yield and Baby corn yield over 111 K plants $ha^{-1}$. However, further increase in plant population (333 K plants $ha^{-1}$) reduced aforesaid yield attributes and yield marginally compared to 160 K plants $ha^{-1}$. Pandey (1997) at Almora (Uttaranchal) reported that maintenance of 133 K plants $ha^{-1}$ significantly enhanced number of cobs $ha^{-1}$ which improved Baby corn yield by 15.13 per cent over 111 K plants $ha^{-1}$. Further increase in plant population to 166 K plants $ha^{-1}$ though improved yield but failed to record statistical significance. However, other parameters *viz.* corn length, corn diameter and fodder yield remained unaffected under various plant densities. Whereas, at Bajaura (Kullu valley), Thakur *et al.* (1997)

reported that in Baby corn crop, maintenance of 250 K plants $ha^{-1}$ significantly reduced stem diameter, cobs per plant, cob weight with and without husk by 12.00, 93.61, 41.92 and 23.87 per cent compared to 83 K plants $ha^{-1}$, respectively. At Ludhiana (Punjab), maintenance of 166 K plants $ha^{-1}$ failed to influence girth of cob however, enhanced number of cobs $ha^{-1}$, length of cob, green fodder yield and Baby corn yield by 50.07, 5.95, 64.67 and 55.78 per cent, respectively over 66 K plants $ha^{-1}$ (Sharma, 1997). In further studies, Sharma (1998) reported that 166 K plants $ha^{-1}$ reduced girth of Baby corn compared to lower plant population of 66 and 125 K plants $ha^{-1}$, however significantly enhanced number of Baby corn and length of Baby corn consequently improved Baby corn and green fodder yield by 31.03, 21.33 and 66.17, 42.19 per cent over 125 K plants $ha^{-1}$ and 66 K plants $ha^{-1}$, respectively. At Jashipur (Orissa), Sahoo and Panda (1999) reported that during *kharif* season varying plant densities failed to influence green fodder yield but highest Baby corn yield was recorded under maintenance of 125 K plants $ha^{-1}$ which was found significantly higher over 100 K plants $ha^{-1}$ but proved at par with 166 K plants $ha^{-1}$. However, under varying plant densities, highest green fodder yield was recorded under 166 K plants $ha^{-1}$ which was found at par with 125 K plants $ha^{-1}$ but proved significantly superior over 100 K plants $ha^{-1}$. In Baby corn + French bean intercropping system, maintenance of 200 K plants $ha^{-1}$ of Baby corn under paired planting system significantly increased cob diameter, cob length, Baby corn yield and fodder yield compared to 166 K plants $ha^{-1}$ (Pandey, 2001). At Almora (Uttaranchal), Pandey *et al.* (2002) observed that maintenance of 111 K plants $ha^{-1}$ significantly increased green cob weight, girth of cob, Baby corn per plant and Baby corn yield compared to 166 K plants $ha^{-1}$. However, girth and length of Baby corn remained unaffected under varying plant densities. Similarly at Chhindwara (M.P.) plant height of Baby corn did not influence under varying plant densities, however, maintenance of 166 K plants $ha^{-1}$ significantly increased number of cobs $ha^{-1}$ which consequently increased Baby corn yield by 10.22 and 33.33 per cent, respectively over 111 K and 83 K plants $ha^{-1}$ (Paradkar, 2004). At Srinagar (J&K), maintenance of 166 K plants $ha^{-1}$ increased number of cobs and Baby corn yield significantly by 24.11, 26.36, 65.25 and 25.61 per cent respectively over 111 and 83 K plants $ha^{-1}$ (Allie, 2005). Alike this, maximum Baby corn yield and number of cobs was recorded under maintenance of 166 K plants ha$^{-1}$ which was found significantly superior over 83 K plants ha$^{-1}$ by 7.8 and 16.58 per cent, respectively, however, proved at par with 111 K plants ha$^{-1}$ (Paradkar, 2005).

**2.1.3 Nutrient Content and Quality**

Vipawon and Anophi (1985) reported that all plant densities under experimentation did not affect seed quality of sweet corn significantly. Ahmedi (1990) recorded effect of plant density on the grain yield on amount of increased number of plants ha$^{-1}$ and reduced grain nitrogen concentration. At Udaipur (Raj.), increasing plant population up to 90 K plants ha$^{-1}$ increased total N uptake by winter maize (Gaur *et al.,* 1992). Singh *et al.* (1997) noted that N, P and K content in maize grain under plant density of 83 K plants ha$^{-1}$ was higher as compared to 66 K plants ha$^{-1}$. Maize grown at 83 K plants ha$^{-1}$ had significantly higher concentration of protein and carbohydrates in the grain compared to 55, 66 and 111 K plants ha$^{-1}$. At Udaipur, on clay loam soils, Meena (2000) observed that per cent sugar content in maize cob was higher under plant density of 66 K plants ha$^{-1}$ (5.43) compared to 5.21 per cent sugar under 133 K plants ha$^{-1}$. Author further reported that the maize grain under plant density of 66 K plants ha$^{-1}$ accumulated significantly higher N and P by 1.6, 0.38 and 0.47, 0.18 per cent, respectively over plant densities of 88 K and 133 K plants ha$^{-1}$. Raja (2001) from Hyderabad reported that kernel quality of sweet corn was not significantly influenced by crop density. Massey (2005) observed that N, P and K content of sweet corn increased significantly with increasing rate of plant population. However, total soluble sugar, protein content, starch content and moisture content of cobs remained unaffected under varying plant densities. Similarly at the same location, but in another trial of pop corn, N and P content of grain and straw were increased significantly with increasing plant population. However, protein content of grain decreases significantly with increasing population (Choudhary, 2005).

**2.2 EFFECT OF FERITILITY LEVELS**

**2.2.1 Growth Characters**

- At Almora (Uttaranchal), days to first harvest remain unaffected significantly under varying dose of nitrogen and its application schedule (Pandey, 1997). Whereas at Bajaura (Kullu Valley), application of 150 kg N $ha^{-1}$ significantly enhanced functional leaves, stem diameter, dry matter per plant and plant height over 50 kg N $ha^{-1}$ and control, however, proved at par with 100 kg N $ha^{-1}$. Similarly, further increase in dose of N (200 kg N $ha^{-1}$) though improved aforesaid parameters but failed to record statistical significance (Thakur *et al.,* 1997). At Ludhiana (Punjab), application of 60 kg N $ha^{-1}$ and 90 kg N $ha^{-1}$ failed to show any perceptible variation in plant stand recorded at harvest of crop (Sharma, 1997). At Almora, application of 120 kg N $ha^{-1}$ significantly improved plant height by 5.86 per cent over 60 kg N $ha^{-1}$, however found at par with 100 kg N $ha^{-1}$ (Pandey, 1998). Experiment conducted for two successive years at Bajaura (Kullu Valley), revealed that application of 150 kg N $ha^{-1}$ significantly increased plant height over 100 kg N $ha^{-1}$. Further increase in N levels to 200 kg N $ha^{-1}$ though improved plant height but failed to record perceptible variation (Thakur and Sharma, 1999). Whereas, at Almora, Pandey (2001) reported that application of 90 kg N $ha^{-1}$ significantly increased plant height over 60 kg N $ha^{-1}$. Further, increase in N levels to 120 kg N $ha^{-1}$ though improved plant height but failed to record perceptible variation. Singh (2001) conducted experiment during two successive seasons of summer and *kharif* and reported that application of 150 kg N $ha^{-1}$ produced maximum dry matter accumulation and plant height which were significantly higher by 14.4, 11.35, 27.39 and 2.00, 4.36, 2.00 per cent over 120 kg N $ha^{-1}$, 90 kg N $ha^{-1}$ and 60 kg N $ha^{-1}$ respectively during summer season whereas, corresponding increase were to the tune of 4.05, 11.21, 22.02 and 1.50, 3.35, 6.59 per cent during *kharif* season. At Jashipur (Orissa), Sahoo (2001) reported that with increase in N levels from 60 kg N $ha^{-1}$ to 180 kg N $ha^{-1}$, harvesting period was reduced significantly. The crop harvested in 69 days under 180 kg N $ha^{-1}$ compared to 72 days under 60 kg N $ha^{-1}$. However, plant height of Baby corn did not influence significantly under various doses of N. On the basis of trial conducted at Chhindwara (M.P.), Paradkar (2004) reported that nitrogen doses failed to bring perceptible variation in plant height. Contrary to above findings days to 50% silking decreased significantly with increasing level of nitrogen. At Srinagar, application of 180 kg N $ha^{-1}$ significantly improved plant height by 1.88 and 4.98 per cent over 120 kg N $ha^{-1}$ and 60 kg N $ha^{-1}$ respectively. Contrary to this plant stand reduced significantly under higher dose of N. The least plant stand of 78 K plants $ha^{-1}$ was recorded under 180 kg N $ha^{-1}$ which was significantly lower compared to plant stand observed under 120 kg N $ha^{-1}$ and 60 kg N $ha^{-1}$ respectively. However, days to 50% silking failed to show perceptible variation under different levels of nitrogen (Allie, 2005). Similarly, at Chhindwara (M.P.), highest plant height was recorded with application of 180 kg N $ha^{-1}$ which was significantly superior over 120 kg N $ha^{-1}$ and 60 kg N $ha^{-1}$. However, application of 180 kg N $ha^{-1}$ significantly reduced plant stand compared to 120 kg N $ha^{-1}$ and 60 kg N $ha^{-1}$. Days to 50% silking did not show perceptible variation under influence of N doses (Paradkar, 2005).

- At Bajaura, application of phosphorus up to 60 kg $P_2O_5$ $ha^{-1}$ failed to record perceptible variation in various growth parameters of Baby corn (Thakur, 1997). Whereas, at same location during another year application of phosphorus in Baby corn proved beneficial as plant height was significantly increased with application of 60 kg $P_2O_5$ $ha^{-1}$ compared to control. However, plant stand remained unaffected (Thakur, 1998).

- At Arbhavi (Karnataka), on medium fertility soils application of 120+40+20 kg N + $P_2O_5$ + $K_2O$ $ha^{-1}$ failed to record perceptible variation in plant stand and plant height of Baby corn over 80+40+20 kg N + $P_2O_5$ + $K_2O$ $ha^{-1}$ (Patil, 1997). Sahoo and Panda (1997) conducted experiment at Jashipur (Orissa), during two seasons and reported that plant population remained unaffected under various fertility levels during winter season. However, during *kharif* season application of 80+17.5+33.3 kg N + $P_2O_5$ + $K_2O$ $ha^{-1}$ significantly increased plant stand over control. Author further observed that increasing levels of fertilizer up to 120+21.8+41.7 kg N + $P_2O_5$ + $K_2O$ $ha^{-1}$ significantly increased plant height however reduced days to harvest initiation compared to control.

-

- **2.2.2 Yield and Yield Attributes**

- The results of the experiment conducted for two successive years revealed significant improvement in yield attributes *viz.*, cobs plant$^{-1}$, cob weight with and without husk consequently Baby corn yield and green fodder yield up to 150 kg N ha$^{-1}$. Further increase in nitrogen level to 180 kg N ha$^{-1}$ though improved yield attributes and yield but failed to record perceptible variation (Thakur *et al.*, 1997). Pandey (1997) conducted experiment at Almora (Uttaranchal), reported that application of 120 kg N ha$^{-1}$ increased number of Baby corn plant$^{-1}$ (3.42 corn per plant) significantly by 8.91 and 40.16 per cent, over 90 kg N ha$^{-1}$ and 60 kg N ha$^{-1}$, respectively. However, Baby corn diameter, length as well as Baby corn and fodder yield remained unaffected under various levels of nitrogen. At Ludhiana (Punjab), application of 90 kg N ha$^{-1}$ significantly increased green fodder yield and number of cobs by 13.15 and 5.31 per cent, respectively over 60 kg N ha$^{-1}$. However, cob length, cob girth and Baby corn yield failed to show perceptible variation under influence of nitrogen doses (Sharma, 1997). At Almora (Uttaranchal), it is recorded that application of 120 kg N ha$^{-1}$ significantly enhanced number of Baby corn per plant and Baby corn yield by 18.72 and 20.72 per cent respectively over 60 kg N ha$^{-1}$ but proved at par with 100 kg N ha$^{-1}$. However, length of cob, cob diameter and green fodder yield failed to record perceptible variation under influence of various levels of N (Pandey, 1998). At Bajaura, Thakur and Sharma (1999) reported that application of 200 kg N ha$^{-1}$ improved ears plant$^{-1}$, length of ears and weight of ears consequently enhanced Baby corn yield by 3.16 and 21.75 per cent over 150 and 100 kg N ha$^{-1}$ during 1995 respectively. Further, the corresponding increase during 1996 were to the tune of 10.28 and 29.76 per cent. Experiment conducted for three successive years revealed that application of 120 kg N ha$^{-1}$ significantly enhanced yield attributes consequently increased Baby corn yield by 7.89 and 21.94 per cent over 90 kg N and 60 kg N ha$^{-1}$ (Pandey *et al.*, 2000). At Coimbatore (Tamil Nadu), Singh (2001) reported that application of 150 kg N ha$^{-1}$ produced highest number of cobs per plant which in turn enhanced Baby corn yield by 4.24, 11.22, 23.55 and 4.34, 11.34, 23.56 per cent over 120, 90 and 60 kg N ha$^{-1}$ during summer and *kharif* seasons, respectively. The corresponding increase in stover yield was to the extent 7.24, 26.06, 65.31 and 7.35, 25.97, 64.74 per cent. At Almora (Uttaranchal), highest number of Baby corn per plant, cob diameter, cob length. Baby corn yield and fodder yield were recorded with application of 120 kg N $ha^{-1}$ which were significantly higher over 80 kg N $ha^{-1}$ and 40 kg N $ha^{-1}$ by 33.33, 5.56, 4.62, 37.10, 13.16 and 33.33, 1.00, 1.47, 65.52, 19.72 per cent, respectively (Pandey, 2001). Sahoo (2001) from Jashipur (Orissa), reported that maximum length and weight of Baby corn was recorded under 180 kg N $ha^{-1}$ which in turn increased Baby corn and fodder yield by 16.62, 86.96 and 21.65, 46.34 per cent respectively. Gaur (2002) from Udaipur (Raj.), reported that application of 150 kg N $ha^{-1}$ significantly enhanced Baby corn and green fodder yield by 16.22, 52.91 and 36.39, 61.17 per cent respectively over 120 kg N $ha^{-1}$ and 90 kg N $ha^{-1}$. Similarly, at Chhindwara (M.P.), Paradkar (2004) reported that application of 180 kg N $ha^{-1}$ significantly increased number of Baby corn and Baby corn yield by 6.09, 19.03 and 19.12, 44.13 per cent, respectively over 120 kg N $ha^{-1}$ and 60 kg N $ha^{-1}$. At Srinagar (J&K), application of 100 kg N $ha^{-1}$ significantly enhanced number of cobs over 120 kg N $ha^{-1}$ and 60 kg N $ha^{-1}$ (Allie, 2005). Similarly in same trial but at another location (Chindwara), highest number of cobs $ha^{-1}$ and Baby corn yield were recorded with application of 180 kg N $ha^{-1}$ which was significantly higher over 120 kg N $ha^{-1}$ and 60 kg N $ha^{-1}$ (Paradkar, 2005).

- At Bajaura (Kullu valley), successive increase in phosphorus levels up to 60 kg $ha^{-1}$ failed to improve various yield attributes and yield of Baby corn (Thakur, 1997). Similarly at the same location but in another year application of phosphorus up to 60 kg $P_2O_5$ $ha^{-1}$ to Baby corn failed to record perceptible variation in various yield attributes, fodder yield and Baby corn yield (Thakur, 1998). Experiment conducted for two successive years at Mayurbhanj (Orissa), revealed that highest Baby corn per plant, Baby corn yield and green fodder yield was recorded with application of 26.2 kg $P_2O_5$ $ha^{-1}$ which were significantly higher by 14.48, 39.84, 5.31 and 10.70, 8.33, 23.81 per cent over 17.5 and 8.7 kg $P_2O_5$ $ha^{-1}$, respectively during 1997. The corresponding increase during 1998 were to the tune of 13.83, 40.29, 10.00 and 11.59, 8.33, 18.13 per cent (Sahoo and Panda, 2001). At Udaipur, Gaur (2002) reported that successive increase in phosphorus dose from 40 kg $P_2O_5$ $ha^{-1}$ to 80 kg

$P_2O_5$ $ha^{-1}$ failed to bring about perceptible variation in Baby corn yield and green fodder yield.

- Application of 120+40+20 kg N + $P_2O_5$ + $K_2O$ $ha^{-1}$ proved beneficial to Baby corn as number of cobs $ha^{-1}$, green fodder yield and Baby corn yield with and without husk was significantly increased compared to 80+40+29 kg N + $P_2O_5$ + $K_2O$ $ha^{-1}$ (Patil, 1997). Similarly, at Jashipur (Orissa), application of 10+21.8+41.7 kg N + $P_2O_5$ + $K_2O$ $ha^{-1}$ significantly improved length of ears, ears $plant^{-1}$, weight of ears, fodder yield and Baby corn yield by 24.62, 38.46, 41.38, 46.60 and 66.88 per cent over control during winter season. The corresponding increases during *kharif* season were 27.78, 78.57, 47.50, 42.40 and 103.6 per cent (Sahoo and Panda, 1997).
-
- **2.2.3 Nutrient Content and Quality**
- At Coimbatore (T.N.), Singh (2001) conducted an experiment for two successive seasons and reported that application of 150 kg N $ha^{-1}$ resulted in maximum crude protein content (%) in Baby corn. The increases were in the tune of 1.23, 4.29 and 10.26 per cent over 120 kg N $ha^{-1}$, 90 kg N $ha^{-1}$ and 60 kg N $ha^{-1}$, respectively in summer season, whereas in *kharif* it was 1.36, 4.62 and 10.41 per cent over 120 kg N $ha^{-1}$, 90 kg N $ha^{-1}$ and 60 kg N $ha^{-1}$, respectively. He further stated that vitamin C content in Baby corn increased with increased doses of N but the difference was non-significant.
- At Udaipur (Raj.), Singh (1990) reported that N and P content in the grain and the stover were significantly increased due to application of 120 kg N $ha^{-1}$ by 7.37, 16.07 and 12.34, 21.57 per cent, respectively over 80 kg N $ha^{-1}$. Similarly, at same location, Singh (1991) observed that application of 90 kg N $ha^{-1}$ significantly enhanced total N, P and K accumulation to the extent of 12.04, 20.02 and 27.76 per cent, respectively over 60 kg N $ha^{-1}$. Singh (1996) reported that application of 120 kg N $ha^{-1}$ significantly increased N concentration in the grain and the stover by 13.18, 12.15 and P concentration by 12.64, 12.31 per cent, respectively over 80 kg N $ha^{-1}$. At Udaipur (Raj.), Singh and Totawat (2002) observed that application of 90 kg N $ha^{-1}$ significantly increased N, P and K content of maize grain and stover to the

extent of 21.24, 20.89, 17.39 and 21.59, 31.40, 17.89 per cent over 67.5 kg N $ha^{-1}$, respectively.

- At Bangalore, application of 75 kg $P_2O_5$ $ha^{-1}$ significantly improved crude protein in popcorn over control (Yogananda *et al.,* 2000).

# 3 MATERIALS AND METHODS

A field experiment entitled **"Effect of Plant Population and Fertility Levels on Yield and Quality of Baby Corn (*Zea mays* L.)"** was conducted during *kharif* 2005. The details of experimental techniques followed, materials used and criteria adopted for treatment evaluation during the course of investigation are presented in this chapter.

## 3.1 EXPERIMENTAL SITE

The experiment was laid out at the Instructional Farm, Rajasthan College of Agriculture, Udaipur which is situated at 23°35'N latitude, 73°42'E longitude and an altitude of 579.5 meters above mean sea level. This region falls under agroclimatic zone IV a (Sub-humid southern plain and Aravali hills) of Rajasthan.

## 3.2 CLIMATE AND WEATHER CONDITIONS

This region has typical sub-tropical climatic conditions characterized by mild winters and moderate summer associated with high humidity especially during months of July to September. The mean annual rainfall of the region is 637 mm, most of which is contributed by Southwest monsoon from July to September. The meteorological observations recorded during the crop period are presented in Table 3.1 and depicted in Fig.3.1. Maximum and minimum temperature during crop growth period ranged between 29.3-35.3°C and 12.5-25.5°C, respectively. The minimum and maximum relative humidity ranged between 77-96 and 28-88 per cent, respectively. Total rainfall received during crop season was 365.2 mm which was well distributed during the crop growth period (Table 3.1).

## 3.3 PHYSICO-CHEMICAL PROPERTIES OF SOIL

In order to estimate physico-chemical properties of soils, samples were drawn from soil up to 30 cm depth before commencement of the experiment and composite sample was prepared. This was subjected to mechanical, physical and chemical analysis to ascertain the physico-chemical properties of the experimental soil. The data (Table 3.2) shows that soils of experimental site was clay loam in texture having alkaline reaction (pH 7.8). The soil was medium in total nitrogen (260.40 kg $ha^{-1}$) and available phosphorus (18.26 kg $ha^{-1}$) but high in available potassium (283.30 kg $ha^{-1}$).

## 3.4 CROPPING HISTORY

Wheat crop was grown in the experimental field in preceding *rabi* season and during summer field was kept fallow.

## 3.5 EXPERIMENAL DETAILS

### 3.5.1 Treatments

The experiment comprised combination of following factors

**(A) Plant population**

| | | |
|---|---|---|
| (i) | 83,333 plants $ha^{-1}$ (60 cm x 20 cm)* | $P_1$ |
| (ii) | 1,11,111 plants $ha^{-1}$ (60 cm x 15 cm)* | $P_2$ |
| (iii) | 1,66,666 plants $ha^{-1}$ (60 cm x 10 cm)* | $P_3$ |
| (iv) | 3,33,333 plants $ha^{-1}$ (60 cm x 5 cm)* | $P_4$ |

**(B) Fertility levels**

| | | |
|---|---|---|
| (i) | 60 kg N + 30 kg $P_2O_5$ $ha^{-1}$ | $F_1$ |
| (ii) | 90 kg N + 35 kg $P_2O_5$ $ha^{-1}$ | $F_2$ |
| (iii) | 120 kg N + 40 kg $P_2O_5$ $ha^{-1}$ | $F_3$ |
| (iv) | 180 kg N + 45 kg $P_2O_5$ $ha^{-1}$ | $F_4$ |

### 3.5.2 Total number of treatments - 16

### 3.5.3 Other experimental details

| | | | |
|---|---|---|---|
| (i) | Number of replications | - | 3 |
| (ii) | Design | - | Randomized block design |
| (iii) | Gross plot size | - | 5 m x 3 m = 15 $m^2$ |
| (iv) | Variety | - | Navjot |

The layout plan of experiment has been shown in Fig.3.2.

---

* While writing Results and Discussion these populations were referred as 83 K, 111 K, 166 K and 333 K plants $ha^{-1}$.

### 3.5.4 Experimental Materials

#### 3.5.4.1 Variety

"Navjot" is recommended composite for rainfed situation was used as test variety. The variety matures in 80-85 days. Plants are medium in height and has dark green foliage. The grains are medium bold and yellow in colour.

#### 3.5.4.2 Fertilizer

As per treatment, full dose of phosphorus, half dose of nitrogen were drilled in furrow 5 cm below seed during sowing through DAP and urea while remainder 50 per cent nitrogen was top dressed at knee high stage through urea.

## 3.6 DETAILS OF CROP RAISING

Details of field operations carried out during crop growth period of Baby corn are presented in Table 3.3.

### 3.6.1 Field Preparation

After harvesting wheat crop, the experimental field was ploughed once with tractor drawn disc plough. With the onset of monsoon, field was prepared by two cross harrowing and planking at appropriate soil moisture. The plots were demarcated as per layout of plan (Fig.3.2) and bunded to separate out each experimental unit.

### 3.6.2 Sowing

As per treatment, treated seeds were sown on $8^{th}$ July 2005. Furrows were opened at 60 cm row distance and seeds were placed at desired plant to plant distance and depth. The seeds were treated with 2 g Bavistin $kg^{-1}$.

### 3.6.3 Weed Control and Interculture

In order to minimize weed competition, pre-emergence application of atrazine at 0.5 kg $ha^{-1}$ followed by one hoeing at 25 DAS was carried out.

### 3.6.4 Irrigation

The experimental crop was raised as rainfed crop.

### 3.6.5 Thinning

At the time of sowing two seeds per hill were dibbled as crop geometry under test. The plants were thinned at 15 days of sowing to obtained a desired plant population.

### 3.6.6 Plant Protection

In order to prevent attack of white grubs and termites, Forate 10 G at 10 kg $ha^{-1}$ was drilled at the time of sowing. Further Endosulfan 35 EC (0.05%) was sprayed in the first fortnight of August as prophylactic measure against common pests.

### 3.6.7 Harvesting

The ears were harvested (45-48 days after crop emergence) when the silks were 1-2 cm long i.e. within 1-2 days after silk emergence. In all there were four picking at an interval of 3 days for complete removal of ears. Harvesting was usually done in the morning when moisture per cent was high and temperature was low. After harvesting, the husk was removed carefully and fresh Baby corns were packed in polythene bags and weighed for individual plots. After final picking the total yield was computed by summing up the yield of individual picking. Before pciking border rows were harvested and removed from experimental field. After last picking, green fodder from net plots were harvested and weighed for individual plots and final green fodder yield was expressed in q $ha^{-1}$.

## 3.7 TREATMENT EVALUATION

In order to evaluate effect of treatment on growth parameters, yield components, yields, nutrient content and their uptake, quality and other aspects of Baby corn, following observations were recorded.

### 3.7.1 Plant Population

The number of plants in net plot area in each experimental unit were counted 20 DAS and at harvest and expressed in K $ha^{-1}$.

### 3.7.2 Phenological Study

#### 3.7.2.1 Days to 50% tasselling

In each experimental unit, days were recorded to their 50% tasselling.

#### 3.7.2.2 Days to 50% silking (2cm)

In each experimental unit, days were recorded to their 50% silking.

#### 3.7.2.3 Days to harvest initiation

Number of days were counted from sowing to the start of harvest from each net plot and recorded to work out the number of days to harvest initiation.

### 3.7.3 Growth Parameters

#### 3.7.3.1 Dry matter accumulation

From each plot, five plants were randomly selected and removed 20, 40 DAS and at harvest. After chopping, plant samples were placed separately in perforated paper bags and oven dried at 65°C till a constant weight is obtained. Later, these were weighed and dry matter was expressed as g plant$^{-1}$.

#### 3.7.3.2 Plant height

Height of five randomly selected plants from each plot were measured from ground level to top of the tassel at harvest and average of height expressed in m.

#### 3.7.3.3 Leaf area index (LAI)

Leaves from five randomly selected plants for each experimental unit were detached 40 DAS and at harvest and categorized as small, medium and large. Using leaf area meter, leaf area index was measured.

#### 3.7.3.4 Functional leaves plant$^{-1}$

From each plot five plants were randomly selected and total physiological active leaves were counted and averaged.

#### 3.7.3.5 Stem diameter

From each experimental unit, five plants were randomly selected and with the help of Vernier Caliper diameter was measured from middle portion of plant and expressed as cm.

### 3.7.4 Yield Attributes

#### 3.7.4.1 Number of ears plant$^{-1}$

Per plot number of ears were counted on each picking, total and average number of ears per plant were computed.

#### 3.7.4.2 Ear length

Five ears were selected randomly from each net plot and were measured to work out average length of ear and expressed as cm.

#### 3.7.4.3 Ear girth

The ears taken for mean length were also subjected to mean girth per ear. Ear thickness was measured with the help of Vernier Caliper and recorded to work out the average ear girth and expressed as cm.

#### 3.7.4.4 Weight of ear (fresh and dry weight)

The ears randomly selected for average length were also subjected to record the fresh weigh and dry weight of the ears and work out the average weight (fresh and dry) of ear and expressed as g.

#### 3.7.4.5 Number of barren plants

Total number of barren plants were counted in net plot area at the time of picking and expressed as number of barren plants ha$^{-1}$.

#### 3.7.4.6 Cob weight with husk

The harvested cobs from each experimental unit were weighed with husk on each picking and total weight of husked cobs from 4 pickings was added and expressed as q ha$^{-1}$.

#### 3.7.4.7 Cob weight without husk (Baby corn yield)

Cob weight without husk was recorded at each picking, averaged and expressed as q ha$^{-1}$.

### 3.7.5 Yield

#### 3.7.5.1 Green ear yield

Green ears obtained from each plot were weighed and used to compute green ear yield and expressed as q $ha^{-1}$.

#### 3.7.5.2 Green fodder yield

Soon after plucking of green cobs, the plants were harvested and bundled according to individual net plot and weighed to obtained final green fodder yield and expressed as q $ha^{-1}$.

#### 3.7.5.3 Biological yield

Biological yield was calculated by summing up the individual net plot weight of net plot green ear and green fodder and expressed as q $ha^{-1}$.

### 3.7.6 Quality Parameters

#### 3.7.6.1 Moisture content of ears

Soon after removal of husk from green ears, they were taken to laboratory and dried in oven at 65°C for 24 hours till a constant weight was achieved. Computing weight of ears before and after oven drying, moisture percentage in the ears was calculated using formula:

$$\text{Moisture per cent} = \frac{\text{Weight of fresh ears} - \text{Weight of dry ears}}{\text{Weight of dry ears}} \times 100$$

#### 3.7.6.2 Protein content of ears

Protein content of Baby corn was calculated by multiplying the nitrogen content of the ears with a factor 6.25 as proposed by Tsen and Martin (1971). It was expressed in terms of per cent protein content.

#### 3.7.6.3 Nutrient content of ears and fodder

The ear and fodder samples collected at harvest from produce of each experimental unit were oven dried at 70°C to a constant weight and grounded in laboratory mill. These samples were subjected to chemical analyse for determination of nutrient contents. The following standard methods for analyses were adopted:

**(i)** **Nitrogen :** Nasseler's reagent colorimetric method (Lindner, 1944).

**(ii)** **Phosphorus :** Ammonium Vanadomolybdate Yellow Colour method (Richard, 1968).

**(iii)** **Carbohydrate :** Anthrone method (Hodge and Hofreiter, 1962).

**(iv)** **Crude protein :** A.O.A.C. method (A.O.A.C., 1975)

**(v)** **Ascorbic acid :** Volumetric method (Sadasivam and Theymoli, 1987).

### 3.7.7 Economics

In order to evaluate the economic viability of different treatments, economics of different treatment combinations was worked out in terms of net returns and B:C. The cost of cultivation from preparatory tillage to harvesting including cost of input viz. seed, fertilizer, plant protection chemicals, irrigation applied to each treatment were computed.

### 3.7.8 Statistical Analysis

The data were subjected to statistical analysis by adopting appropriate analysis of variance as described by Cocharan and Cox (1967). Wherever the F values were found significant at 5 per cent level of probability, the critical difference (CD) values were computed for making comparison among the treatment means. In order to establish interrelationship between various components, coefficient of correlation and regression equations were computed as described by Panse and Sukhatme (1985).

**Table 3.1 Mean weekly meteorological parameters during crop growing season (*kharif* 2005)**

| Standard week No. | Period | Temperature (°C) | | Relative humidity (%) | | Sunshine hrs per day | Evaporation (mm/day) | Total rainfall (mm) | Wind velocity (kg $hr^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|
| | | Max. | Min. | Max. | Min. | | | | |
| 27 | 2 – 8 July | 31.9 | 24.2 | 83 | 63 | 5.7 | 6.2 | 0.0 | 6.6 |
| 28 | 9 – 15 July | 32.1 | 25.5 | 84 | 66 | 5.5 | 6.2 | 0.0 | 7.4 |
| 29 | 16 – 22 July | 33.0 | 25.8 | 83 | 67 | 5.0 | 6.8 | 0.0 | 7.6 |
| 30 | 23 – 29 July | 33.0 | 24.5 | 85 | 69 | 4.6 | 6.3 | 158.2 | 6.2 |
| 31 | 30 July – 5 Aug. | 28.7 | 23.7 | 96 | 88 | 2.2 | 3.0 | 145.4 | 2.2 |
| 32 | 6 – 12 Aug. | 28.5 | 23.3 | 95 | 81 | 2.4 | 3.5 | 0.0 | 5.4 |
| 33 | 13 – 19 Aug. | 30.9 | 23.5 | 90 | 65 | 3.9 | 3.9 | 0.0 | 2.7 |
| 34 | 20 – 26 Aug. | 30.3 | 22.5 | 80 | 57 | 7.7 | 5.4 | 0.0 | 3.6 |
| 35 | 27 Aug. – 2 Sept. | 32.5 | 22.3 | 80 | 46 | 9.3 | 5.6 | 0.0 | 1.8 |
| 36 | 3 – 9 Sept. | 35.3 | 23.2 | 77 | 50 | 6.6 | 5.9 | 61.6 | 2.1 |

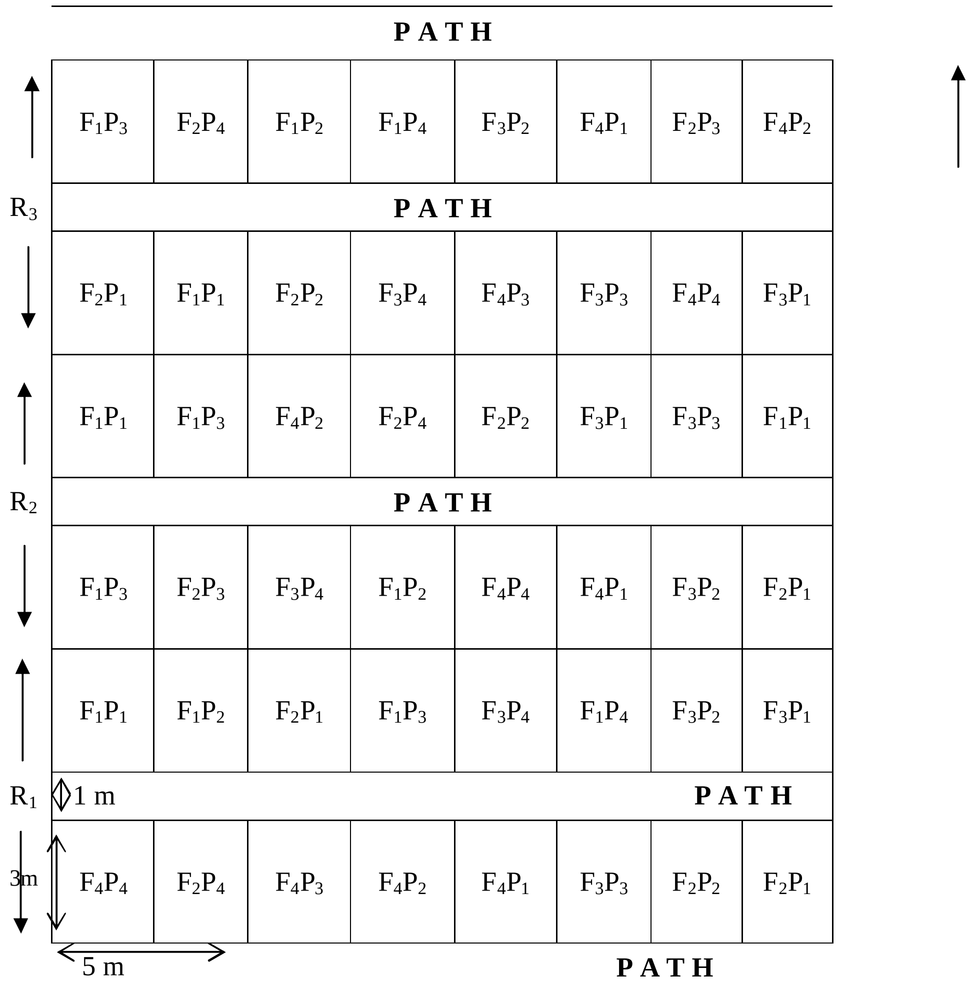
**Source :** Agro Meteorological Observatory, Rajasthan College of Agriculture, Udaipur.

**Table 3.2 Mechanical, physical and chemical properties of experimental soils**

| S.No. | Properties | Contents | Method employed |
|---|---|---|---|
| **A** | **Mechanical composition** | | Hydrometer method (Bouyoucous, 1962) |
| 1 | Sand (%) | 38.2 | |
| 2 | Silt (%) | 27.7 | |
| 3 | Clay (%) | 33.2 | |
| 4 | Texture class | Clay loam | Triangular diagram (Brady, 1983) |
| **B** | **Physical properties** | | |
| 1 | Bulk density (Mg $m^{-3}$) | 1.38 | Core sampler method (Piper, 1950) |
| 2 | Particle density (Mg $m^{-3}$) | 2.63 | Black (1965) |
| 3 | Porosity (%) | 47.53 | Black (1965) |
| **C** | **Chemical properties** | | |
| 1 | Organic carbon (%) | 0.74 | Walkley and Black (1947) |
| 2 | Total nitrogen (kg $ha^{-1}$) | 260.40 | Alkaline $KMnO_4$ method (Subbiah and Asija, 1956) |
| 3 | Available phosphorus (kg $ha^{-1}$) | 18.26 | Olsen's method (Olsen *et al.*, 1954) |
| 4 | Available potassium (kg $ha^{-1}$) | 283.30 | Flame Photometer (Jackson, 1973) |
| 5 | Electrical conductivity (dS $m^{-1}$ at 25°C) | 0.88 | Conductivity bridge (Richard, 1968) |
| 6 | pH (1:2.5 soil : water ratio) | 7.8 | pH meter (Piper, 1950) |

**Table 3.3 Schedule of field operations during crop growth period of Baby corn**

| S.No. | Operation | Date |
|---|---|---|
| 1 | Field operation | 7.7.2005 |
| 2 | Layout of bunding | 8.7.2005 |
| 3 | Sowing and fertilizer application | 8.7.2005 |
| 4 | Spray of atrazine (0.5 kg $ha^{-1}$) | 8.7.2005 |
| 5 | Hoeing and thinning | 22.7.2005 |
| 6 | Fertilizer application ($2^{nd}$ dose) | 5.8.2005 |
| 7 | Plant protection | |
| | (i) Forate application | 7.7.2005 |
| | (ii) Insecticide spray | 10.8.2005 |
| 8 | Harvesting | |
| | (i) First picking | 25.8.2005 |
| | (ii) Second picking | 27.8.2005 |
| | (iii) Third picking | 31.8.2005 |
| | (iv) Fourth picking | 2.9.2005 |
| 9 | Harvesting of crop for fodder purpose | 4.9.2005 |




**Plant population :**

**Fertilizer levels ($N+P_2O_5$ $ha^{-1}$) :**

$P_1$ = 83 K (60 cm x 20 cm)
$F_1$ = 60 kg + 30 kg
$P_2$ = 111 K (60 cm x 15 cm)
$F_2$ = 90 kg + 35 kg
$P_3$ = 166 K (60 cm x 10 cm)
$F_3$ = 120 kg + 40 kg
$P_4$ = 333 K (60 cm x 5 cm)
$F_4$ = 180 kg + 45 kg

## FIG. 3.2 PLAN OF LAYOUT

# 4 EXPERIMENTAL RESULTS

The results of field experiments entitled “Effect of Plant Population and Fertility Levels on Yield and Quality of Baby Corn (*Zea mays* L.)” conducted at Instructional Farm, Rajasthan College of Agriculture, Udaipur during *kharif* 2005 are being presented in this chapter. Data pertaining to effect of treatments on various aspects of growth, yield components, yield, nutrient content and quality of Baby corn were statistically analyzed to test significance of the results. The results for main effects have been described invariably in succeeding paragraphs. The analysis of variance has been furnished in the Appendices at the end (I to XII). The interaction effect of plant population and fertility levels did not influence the studied parameters, significantly.

## 4.1 EFFECT OF TREATMENTS ON PLANT POPULATION OF BABY CORN

Plant population 20 DAS and at harvest are presented in Table 4.1 and their analysis of variance in Appendix-I.

**(a) Effect of Plant Population**

Plant population of Baby corn both 20 DAS and at harvest differed statistically because of varied crop geometry (Table 4.1).

**(b) Effect of Fertility Levels**

Varied fertility levels did not influence plant population of Baby corn 20 DAS and at harvest (Table 4.1).

## 4.2 EFFECT OF TREATMENTS ON PHENOLOGICAL PARAMETERS OF BABY CORN

Recorded data on different phenological parameters under influence of different treatments are presented in Table 4.2 and analysis of variance in Appendix-II.

### 4.2.1 Days to 50 per cent tasselling

It is explicit from data (Table 4.2) that plant population and fertility levels failed to show any perceptible variation in days to 50 per cent tasselling.

### 4.2.2 Days to 50 per cent silking

Plant population and fertility levels did not bring any change in days to 50 per cent silking, significantly (Table 4.2).

### 4.2.3 Days to harvest initiation

Plant population and fertility levels did not influence days to harvest initiation, significantly (Table 4.2).

## 4.3 EFFECT OF TREATMENTS ON GROWTH PARAMETERS

Recorded data on different growth parameters under the influence of different treatments are presented in Table 4.3 and analysis of variance in Appendix-III and IV.

### 4.3.1 Dry matter accumulation

**(a) Effect of plant population**

Per plant accumulation varied significantly under influence of different plant population. Maximum dry matter accumulation was recorded with plant population of 83 K plants $ha^{-1}$ which was found significantly higher over 111 K plants $ha^{-1}$ 20 and 40 DAS and at harvest (Table 4.3). Dry matter accumulation at higher density (166 K and 333 K plants $ha^{-1}$) did not differ statistically but yielded less dry matter accumulation to 83 K plants $ha^{-1}$ 20 and 40 DAS and at harvest (Table 4.3)

**(b) Effect of fertility levels**

An application of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ significantly enhanced per plant dry matter accumulation by 39.2 per cent over 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$ at 20 and 40 DAS and at harvest (Table 4.3). Further increase in fertilizer levels up to 180 kg N and 45 kg $P_2O_5$ $ha^{-1}$ though increased dry matter accumulation but failed to record statistical significance at all the three stages of plant growth.

### 4.3.2 Plant height at harvest

#### (a) Effect of plant population

Plant height was significantly increased up to population of 166 K plants $ha^{-1}$ (2.00 m) but further increase in plant population gave non-significant response (Table 4.3).

#### (b) Effect of fertility levels

An application of 120 kg N and 40 kg $P_2O_5$ $ha^{-1}$ recorded significantly higher plant height (2.08 m) which was 12.43 and 19.23 per cent higher over 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ and 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$, respectively. Further increase in fertility level up to 180 kg N and 45 kg $P_2O_5$ $ha^{-1}$ did not show statistical significance over 120 kg N and 40 kg $P_2O_5$ $ha^{-1}$ (Table 4.3).

### 4.3.3 Leaf area index (LAI)

#### (a) Effect of plant population

Leaf area index increased with increasing plant population. Maximum leaf area index (4.28 and 4.32) was recorded with 333 K plants $ha^{-1}$ 40 DAS and at harvest which were found significantly higher over 166 K, 111 K and 83 K plants $ha^{-1}$ by 11.74 to 30.48 and 11.62 to 49.48 per cent, respectively (Table 4.3.).

#### (b) Effect of fertility levels

It is apparent from the data that increasing level of fertility did not show any perceptible variation and differed non-significantly from each other (Table 4.3).

### 4.3.4 Functional leaves $plant^{-1}$

Functional leaves $plant^{-1}$ of Baby corn failed to show any perceptible variation under the influence of different plant population and fertilizer levels (Table 4.3).

### 4.3.5 Stem diameter

#### (a) Effect of plant population

Stem diameter decreased with increase in plant population. Highest stem diameter (2.2 cm) was recorded with 83 K plants $ha^{-1}$ which was found significantly superior over 111 K, 166 K and 333 K plants $ha^{-1}$ by 6.22, 13.26 and 17.46 per cent, respectively (Table 4.3).

**(b) Effect of fertility levels**

It is apparent from data (Table 4.3) that increasing levels of fertilizer up to 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ improved stem diameter significantly by 15.55 per cent over 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$ (1.80 cm). Further increase in fertilizer levels though increased stem diameter but did not record perceptible variation.

## 4.4 EFFECT OF TREATMENTS ON YIELD ATTRIBUTES OF BABY CORN

Data on yield attributes of the crop under the influence of various treatments are presented in Table 4.4 to 4.6 and relevant analysis of variance in Appendix-V to VII.

### 4.4.1 Number of ears plant$^{-1}$

**(a) Effect of plant population**

There was found significant variation in number of ears plant$^{-1}$ within plant population. The highest number of ears plant$^{-1}$ (1.28) was recorded under lower plant population of 83 K plans ha$^{-1}$ which was found at par with 111 K and 166 K plants ha$^{-1}$ however, proved significantly superior over higher plant population *viz.* 333 K plants ha$^{-1}$ (Table 4.4).

**(b) Effect of fertility levels**

An application of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ significantly enhanced number of ears plant$^{-1}$ by 7.96 per cent over 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$ (1.13). Further increase in fertility levels though increased number of ears plant$^{-1}$ but failed to record perceptible variation (Table 4.4).

### 4.4.2 Ear length

**(a) Effect of plant population**

Contrary to number of ears plant$^{-1}$, maximum ear length of Baby corn (8.84 cm) was recorded under the population of 333 K plants ha$^{-1}$ which was found significantly superior over 166 K, 111 K and 83 K plants ha$^{-1}$. The magnitude of improvement in ear length were 12.89, 51.11 and 75.39 per cent, respectively (Table 4.4 and Fig.4.1).

**(b) Effect of fertility level**

Increasing levels of fertility up to 180 kg N and 45 kg $P_2O_5$ $ha^{-1}$ improved ear length of Baby corn, however, statistical superiority was recorded up to 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ over 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$ by 14.61 per cent (Table 4.4 and Fig.4.1).

### 4.4.3 Ear girth

**(a) Effect of plant population**

Alike number of ears $plant^{-1}$, maximum ear girth (1.50 cm) was recorded under 83 K plants $ha^{-1}$ showing significant increase over 111 K, 166 K and 333 K plants $ha^{-1}$ by 7.14, 16.27 and 48.51 per cent, respectively (Table 4.4 and Fig.4.1).

**(b) Effect of fertility levels**

Data further explicit almost similar trend of fertility on ear girth, as observed in number of ears $plant^{-1}$. Amongst fertilizer levels, application of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ significantly enhanced ear girth by 10.00 per cent over 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$ (1.20 cm). Further increase in fertilizer levels though increased ear girth but difference were not statistically significant (Table 4.4 and Fig.4.1).

### 4.4.4 Fresh weight of ear

**(a) Effect of plant population**

Ear obtained from plant population of 83 K plants $ha^{-1}$ had significantly higher fresh weight (13.51 g) over that of recorded under 111 K, 166 K and 333 K plants $ha^{-1}$ (5.1-12.41 g). The magnitude of increase in fresh weight of ear was to the tune of 8.86, 23.42 and 16.31 per cent, respectively (Table 4.5).

**(b) Effect of fertility levels**

Amongst fertilizer levels, fresh weight of ear (10.47 g) obtained under 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ was significantly higher over preceding level of 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$ by 16.72 per cent. Further increase in fertilizer levels up to 180 kg N and 45 kg $P_2O_5$ $ha^{-1}$ though improved fresh weight however proved statistically at par (Table 4.5).

### 4.4.5 Dry weight of ear

#### (a) Effect of plant population

An examination of data further explicit almost similar trend of plant population on dry weight of ear as observed in its fresh weight. Amongst plant population maintenance, 83 K plants $ha^{-1}$ produced highest dry ear weight (11.97 g $ear^{-1}$) which was significantly higher over that of recorded under 111 K, 166 K and 333 K plants $ha^{-1}$ by 9.11, 28.70 and 163.07 per cent, respectively (Table 4.5).

#### (b) Effect of fertility levels

An application of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ significantly enhanced dry weight of ears by 16.60 per cent over 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$ (7.95 g $ear^{-1}$). Further increase in fertilizer doses though improved average dry weight of ear but failed to record statistical significance (Table 4.5).

### 4.4.6 Number of barren plants

#### (a) Effect of plant population

An examination of recorded data indicate that increasing rate of plant population significantly enhanced barrenness of Baby corn. Highest number of barren plants $ha^{-1}$ (2330 plants) was recorded with the plant population of 333 K plants $ha^{-1}$ which was 87.90 to 529.63 per cent higher over 166 K, 111 K and 83 K plants $ha^{-1}$ (Table 4.6). There was found lowest barrenness with 83 K plants $ha^{-1}$ (370 plants $ha^{-1}$).

#### (b) Effect of fertility levels

Contrary to plant population, increasing levels of fertility reduced barrenness of Baby corn. The least number of barren plants (95 plants $ha^{-1}$) was recorded with highest level of fertilizer (180 kg N and 40 kg $P_2O_5$ $ha^{-1}$) which was significantly low as compared to 120 kg N and 40 kg $P_2O_5$ $ha^{-1}$ (13.68%), 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ (29.47%) and 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$ (30.50%) [Table 4.6].

### 4.4.7 Cob weight with husk

#### (a) Effect of plant population

Data (Table 4.6) explicit that increasing level of plant population up to 111 K plants $ha^{-1}$ improved cob weight with husk significantly by 15.09 per cent over 83 K plants $ha^{-1}$ (41.26 q $ha^{-1}$). Further increase in plant population levels improved the cob weight with husk but failed to record statistical significance.

**(b) Effect of fertility levels**

An application of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ significantly enhanced cob weight with husk by 16.45 per cent over 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$ (43.89 q $ha^{-1}$) (Table 4.6). Further increase in fertilizer dose though improved weight of cob with husk but proved statistically at par.

## 4.5 EFFECT OF TREATMENTS ON THE YEILDS OF BABY CORN

The influence of various treatments on Baby corn productivity are presented in Table 4.7 and depicted in Fig.4.2. The analysis of variance for aforesaid parameters are presented in Appendix-VIII.

### 4.5.1 Baby corn yield

**(a) Effect of plant population**

Maintenance of 166 K plants $ha^{-1}$ exhibited significant superiority in the yield of Baby corn ear (17.26 q $ha^{-1}$) over other population densities under test (11.07 to 16.25 q $ha^{-1}$). The extent of increase in Baby corn yield was to the tune of 55.91, 29.38 and 6.21 per cent over 333 K, 111 K and 83 K plants $ha^{-1}$, respectively (Table 4.7 and Fig.4.2).

**(b) Effect of fertility levels**

An application of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ yielded 14.72 q $ha^{-1}$ Baby corn ear which was found at par with their higher doses (120 kg N and 40 kg $P_2O_5$ $ha^{-1}$ and 180 kg N and 45 kg $P_2O_5$ $ha^{-1}$) but found statistical superior over 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$ by 20.52 per cent (Table 4.7 and Fig.4.2).

### 4.5.2 Green fodder yield

**(a) Effect of plant population**

Amongst plant population, 166 K plants $ha^{-1}$ significantly increased green fodder yield (243.56 q $ha^{-1}$) by 19.65 and 34.15 per cent over 111 K and 83 K plants $ha^{-1}$, respectively. Further, increase in plant population up to 333 K plants $ha^{-1}$

reduced green fodder yield marginally (4.71%) compared to 166 K plants $ha^{-1}$ (Table 4.7and Fig.4.2).

**(b) Effect of fertility levels:**

Data (Table 4.7 and Fig.4.2) explicit that an application of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ enhanced green fodder yield by 22.25 per cent over 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$ (179.75 q $ha^{-1}$) but further increase in fertility levels improved fodder production but differences were not found statistically significant.

### 4.5.3 Biological yield

**(a) Effect of plant population**

Alike Baby corn and green fodder yields, increasing rate of plant population up to 166 K plants $ha^{-1}$ significantly enhanced biological yield (260.82 q $ha^{-1}$) and the magnitude of increase was to be the tune of 19.46 and 34.60 per cent, over 111 K and 83 K plants $ha^{-1}$. However, further increase in plant population 333 K plants $ha^{-1}$ tended to reduce biological yield marginally (3.21%) but found statistically at par (Table 4.7 and Fig.4.2).

**(b) Effect of fertility levels**

Amongst fertilizer levels, an application of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ increased the biological yield significantly by 21.10 per cent over 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$ (223.64 q $ha^{-1}$). Further increase in fertility levels *viz.* 120 kg N and 40 kg $P_2O_5$ $ha^{-1}$ and 180 kg N and 45 kg $P_2O_5$ $ha^{-1}$ though increased biological yield (283.71 q $ha^{-1}$ and 285.89 q $ha^{-1}$) but found statistically at par with 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ (Table 4.7 and Fig.4.2).

## 4.6 EFFECT OF TREATMENTS ON QUALITY PARAMETERS OF BABY CRON

The estimates of quality parameters under the influence of treatments are presented in Table 4.8 and analysis of variance have been furnished in Appendix-IX.

### 4.6.1 Moisture content of Baby corn ear

**(a) Effect of plant population**

Amongst plant population, the highest moisture content (12.00%) was recorded in ears obtained from plant population of 333 K plants ha$^{-1}$ which was statistically superior to the other plant densities under test. The magnitude of aforesaid increase was to the tune of 5.5, 5.9 and 6.7 per cent over 166, 111 and 83 K plants ha$^{-1}$ respectively (Table 4.8).

**(b) Effect of fertility levels:**

An application of 120 kg N and 40 kg $P_2O_5$ ha$^{-1}$ recorded significantly higher moisture content in Baby corn ear by 3.53 per cent over that of application of 60 kg N and 30 kg $P_2O_5$ ha$^{-1}$ (11.22%) but found at par with 90 kg N and 35 kg $P_2O_5$ ha$^{-1}$ and 180 kg N and 45 kg $P_2O_5$ ha$^{-1}$ (Table 4.8).

### 4.6.2 Protein content of Baby corn ear

**(a) Effect of plant population**

Increasing plant density up to 111 K plants ha$^{-1}$ significantly increased protein content of ears by 8.3 per cent over 83 K plants ha$^{-1}$ (11.40%). Further increase in plant population from 111 K to 166 K plants ha$^{-1}$ and 166 K to 333 K plants ha$^{-1}$ reduced protein content of ears (11.57 and 11.89 per cent) compared to its lower levels (Table 4.8).

**(b) Effect of fertility levels**

An application of 120 kg N and 40 kg $P_2O_5$ ha$^{-1}$ significantly enhanced protein content of ears by 3.50 and 17.74 per cent, respectively over 90 kg N and 35 kg $P_2O_5$ ha$^{-1}$ and 60 kg N and 30 kg $P_2O_5$ ha$^{-1}$. Further increase in fertilizer level (180 kg N and 45 kg $P_2O_5$ ha$^{-1}$) though improved protein content of ears however failed to inflict statistical significance.

### 4.6.3 Carbohydrate content of Baby corn ear

**(a) Effect of plant population**

The estimate of carbohydrate content explicit almost similar trend of plant population as observed in protein content. Maintenance of 166 K plants ha$^{-1}$ produced highest carbohydrate content in Baby corn ears (11.00 g) over that of recorded in 111 K (10.52 g) and 83 K plants ha$^{-1}$ (10.50 g). However, further increase in plant population (333 K plants $ha^{-1}$) decreased carbohydrate content significantly by 4.00 per cent, compared to 166 K plants $ha^{-1}$ (Table 4.8).

**(b) Effect of fertility levels**

An application of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ significantly enhanced carbohydrate content by 3.33 per cent over 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$ (10.45 g). Further increase in fertilizer levels though enhanced carbohydrate content, however, failed to record statistical significance (Table 4.8).

### 4.6.4 Ascorbic acid content of Baby corn ears

**(a) Effect of plant population**

It is apparent from data that highest ascorbic acid content in Baby corn ears was recorded under maintenance of 166 K plants $ha^{-1}$ (8.27 mg) which was found statistically at par with 111 K and 333 K plants $ha^{-1}$ but significantly higher over 83 K plants $ha^{-1}$ by 10.70 per cent (7.47 mg) (Table 4.8).

**(b) Effect of fertility levels**

The data indicate that fertilizer levels did not contribute significantly in ascorbic acid content of ears, however, there was trend of apparent increase in ascorbic acid content with increase in fertility status (Table 4.8).

### 4.6.5 Crude protein content of fodder

**(a) Effect of plant population**

Estimation of crude protein content of fodder reveals that maintenance of 333 K plants $ha^{-1}$ yielded maximum crude protein content (10.65%) in green fodder over that of recorded in 166 K, 111 K and 83 K plants $ha^{-1}$ (6.73, 9.04 and 9.92%) (Table 4.8).

**(b) Effect of fertility levels**

Data (Table 4.8) further explicit that an application of 180 kg N and 45 kg $P_2O_5$ $ha^{-1}$ enhanced crude protein content of fodder (9.88%) by 1.8, 1.2 and 0.6 per cent, over 60 kg N and 30 kg $P_2O_5$, 90 kg N and 35 kg $P_2O_5$ and 120 kg N and 40 kg $P_2O_5$ $ha^{-1}$, respectively.

## 4.7 EFFECT OF TREATMENTS ON NUTRIENT CONTENT OF BABY CORN

The estimates of N and P content under influence of treatments are presented in Table 4.9 and respective analysis of variance have been furnished in Appendix-X.

### 4.7.1 Nitrogen content of ears

**(a) Effect of plant population**

Amongst plant population, maximum N content of Baby corn ears (1.97%) was estimated under plant population level of 166 K $ha^{-1}$ which was found at par with its lower (111 K plants $ha^{-1}$) level but proved significantly superior over 83 K and 333 K plants $ha^{-1}$ by 8.24 and 6.49 per cent (Table 4.9 and Fig.4.3).

**(b) Effect of fertility levels**

An application of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ significantly enhanced N content of Baby corn ears over 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$ but found at par with higher level of fertility (120 kg N and 40 kg $P_2O_5$ and 180 kg N and 45 kg $P_2O_5$ $ha^{-1}$).

### 4.7.2 Nitrogen content of fodder

**(a) Effect of plant population**

Maximum N content of fodder (0.84%) was estimated by maintaining plant density of 166 K plants $ha^{-1}$ which was significantly higher over 83 K and 333 K plants $ha^{-1}$ by 19.01 and 19.00 per cent, respectively however proved at par with that of N content recorded under 111 K plants $ha^{-1}$ (Table 4.9 and Fig.4.3).

**(b) Effect of fertility levels**

Amongst fertilizer levels, an application of 90 kg N and 35 kg $P_2O_5$ recorded significantly higher N content in fodder over that of recorded under 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$. Further improvement in fertilizer levels up to 180 kg N and 45 kg $P_2O_5$ $ha^{-1}$ did not influence N content of fodder, significantly (Table 4.9 and Fig.4.3).

### 4.7.3 Phosphorus content of ears

**(a) Effect of plant population**

Amongst plant population, maintenance of 166 K plants $ha^{-1}$ recorded highest P content in Baby corn ears (3.78%) which was significantly higher over 111 K and

83 K plants $ha^{-1}$ by 15.24 and 32.63 per cent, respectively. Further increase in plant population levels (333 K plants $ha^{-1}$) reduced P content significantly by 15.24 per cent compared to 166 K plants $ha^{-1}$ (Table 4.9 and Fig.4.4).

**(b) Effect of fertility levels**

Fertility levels did not record perceptible variation in P content of Baby corn ears (Table 4.9 and Fig.4.4).

### 4.7.4 Phosphorus content of fodder

**(a) Effect of plant population**

The highest P content in fodder was estimated with maintenance of plant population of 166 K plants $ha^{-1}$ (0.148%) which was significantly higher by 2.77, 2.77 and 11.2 per cent over 333 K, 111 K and 83 K plants $ha^{-1}$, respectively (Table 4.9 and Fig.4.4).

**(b) Effect of fertility levels**

Maximum P content in Baby corn fodder was recorded at fertility levels of 120 kg N and 40 kg $P_2O_5$ $ha^{-1}$ (0.142%) which was significantly higher over 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$. But, further increase of fertility levels up to 180 kg N and 45 kg $P_2O_5$ $ha^{-1}$ did not show any improvement in P content of fodder (Table 4.9 and Fig.4.4).

## 4.10 EFFECT OF TREATMENTS ON N AND P CONTENT IN SOIL AFTER BABY CORN HARVEST

The estimates of N and P contents in soil after harvest of Baby corn under the influence of various treatments are presented in Table 4.10. The respective analysis of variance have been given in Appendix-XI

It is revealed from data (Table 4.10) that plant population and fertility levels did not influence N and P contents of soil after harvest of Baby corn, significantly.

## 4.9 EFFECT OF TREATMENTS ON RELATIVE ECONOMICS

Computation of data on relative economics (net returns and B:C) of various treatments are presented in Table 4.11. The analysis of variance and details of conclusion are furnished in Appendix-XII.

### (a) Effect of plant population

Amongst plant population, maintenance of 166 K plants $ha^{-1}$ significantly improved net return (Rs.25400 $ha^{-1}$) and B:C (2.00) and recorded statistical superiority over 111 K and 83 K plants $ha^{-1}$ with net return of Rs.14540 to 19240 $ha^{-1}$ and B:C of 1.29 to 1.63 (Table 4.11). The magnitude of increase in net returns with increase in plant population from 83 K to 111 K plants $ha^{-1}$ and 111 K to 166 K plants $ha^{-1}$ was Rs.4700 and Rs.6160 respectively. Further increase in plant population from 166 K to 333 K plants $ha^{-1}$ reduced net returns and B:C, respectively.

### (b) Effect of fertility levels:

Maximum net returns of Rs.22070 $ha^{-1}$ was recorded at fertility level of 120 kg N and 40 kg $P_2O_5$ which was significantly higher over 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$ (Rs.14750 $ha^{-1}$) but proved at par with 90 kg N and 35 kg $P_2O_5$ and 180 kg N and 45 kg $P_2O_5$ $ha^{-1}$. However, application of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ proved most economic dose as it recorded highest B:C (1.73) (Table 4.11) .

# 5 DISCUSSION

While presenting the results of the field experiment entitled "Effect of Plant Population and Fertility Levels on Yield and Quality of Baby Corn (*Zea mays*)" significant variation in the criteria used for evaluation of treatments were observed. Such variations as well as uniform trends are discussed in this chapter in the light of solvent evidences and positive explanations so as to establish the cause and effect relationship.

## 5.1 EFFECT OF PLANT POPULATION

### 5.1.1 Growth parameters

The results (Table 4.1 to 4.3) revealed that plant population of Baby corn differed significantly 20 DAS and at harvest. However, days to 50% silking, days to 50% tasseling and days to harvest initiation failed to show perceptible variation under the influence of plant densities. The crop under the influence of 83 K plant $ha^{-1}$ density accumulated maximum dry matter at various growth stages compared to other densities under test. Contrary, the plant height and LAI were increased with increasing plant densities. Functional leaves did not influence with varied plant densities. Similarly, stem diameter was maximum at 83 K plant $ha^{-1}$ compared to highest plant density under test (333 K plant $ha^{-1}$). It is an established fact that growth of crop is outcome of genomic and environmental interaction. The same variety was grown under different plant densities under identical agronomic environment (management practices), the observed similarities in phonological parameter could be ascribed to its internal genetic milieu. However, under present investigation the profound influence of population density on performance of Baby corn crop could be an area available for each plant which indirectly dictated the availability of various growth inputs to individual plants in the community and also the extent of competition between and within the plants for various growth inputs.

The significant improvement in plant height and reduction in stem diameter with increased population densities seems to be the resultant of mutual shading due to over crowding of plants. Hozumi *et al.* (1955) established this as a "cooperative interaction" wherein smaller plants tend to catch-up with the taller ones by means of it and compete more on even terms. Mutual shading under increased population might have reduced the availability of light within the crop canopy and accelerated elongation of lower internodes resulting into increased plant height and decrease in stem diameter. The observed behavior of maize under increased population densities is in close conformity with the statement of Donald (1963). Kailash (2003) opined that in most of the crops, up to certain level of population, plants elongate due to mutual shading and reduced availability of photosynthates. Cause and effect analysis further substantiated that higher plant density reduced space available to individual plant which might have intensified competition for development and prolification of roots thus affecting that root activity for extraction and availability of nutrients from soil profile in plant system. Whereas, maintaining 83 K plants $ha^{-1}$ right from sowing provided appropriate space to individual plants which in turn reduced competition for under ground and above ground part of plant. This was by virtue of better development and prolification of root, extraction of nutrient from soil profile was higher. Under present investigation it is clearly evident from analysis of soil carried out at harvest of crop (Table 4.10). The nutritional status viz., N and P content decreased rapidly as plant population was increased. It is an established fact that N and P is considered to be important for growth and development of crop. The higher availability of N and P in plant part of crop under 83 K plants $ha^{-1}$ was closely followed by plant density 111 K and 166 K plants $ha^{-1}$. This might have promoted growth of individual plant by way of active cell division and elongation resulting in formation of higher number of leaves with higher leaf area duration. Besides this, adequate mineral nutrient might led to improvement in chlorophyll content of leaves. Increased chlorophyll content is believed to strongly influence the extinction coefficient which has direct bearing on light interception (Donald, 1963).This concomitant effect of improved nutritional status and chlorophyll content of leaves under 83 K plants $ha^{-1}$ maintained right from sowing seems to have higher accumulation of photosynthates and finally dry matter accumulation by individual plants. Bhatia (1964) also emphasized that under appropriate plant density, leaves $plant^{-1}$ result in larger canopy development which led to efficient photosynthetic activities and greater accumulation of photosynthates in maize plants. The observed improvement in overall growth of the maize under lower plant density compared to higher plant densities is in close agreement with the findings of Aulakh (1998), Patel and Patel (2002) and Kailash (2003). Further increase in LAI 40 DAS and at harvest with increase in plant population was on account of varied crop geometry. The result is in close accordance with findings of Sahoo (1995), Patil (1997) and Pandey (1999).

### 5.1.2 Yield Attributes and Yield

It was observed that yield attributing parameters viz., number of ear plant$^{-1}$, ear girth, weight of ears both fresh and dry were higher with lower plant densities. However, ear length, number of barren plant ha$^{-1}$ and cob weight increased with increase in plant densities. The crop under influence of 166 K plants ha$^{-1}$ produced highest Baby corn, green fodder and biological yield.

The marked improvement in yield attributes viz. number of ear plant$^{-1}$, ear girth and weight of ear under population density of 83 K plants ha$^{-1}$ seems to be due to vigorous growth of individual plant as reflected by increased total dry matter production plant$^{-1}$. It is an established fact that in crops, availability of assimilates (source) and storages organ (sink) exerts an important regulatory function on the complex process of yield formation. In maize crop, the synthesis of photosynthates at later stage of crop growth exert profound influence on growth and development of storage structure. Thus higher nutritional status during reproductive and maturity phase under said population densities resulted in higher photosynthesis and finally dry matter accumulation. Higher dry matter is believed to have maintained adequate supply of metabolites for development of reproductive structures. The regression analysis also revealed dependence of ear plant$^{-1}$, ear girth and weight of ear (fresh and dry) on dry matter production. The unit increase in dry matter production at harvest increased by 0.564 ear plant$^{-1}$, 0.829 cm ear girth. Improvement in yield attributes of Baby corn under lower plant densities and reduction in these with increased population as evidenced from the present investigation is in close agreement with the findings of Tyagi *et al.* (1998) Sen *et al.* (1999), Kailash (2003) and Allie (2005). Ear length of Baby corn increased with increased plant densities might be on account of mutual shading resulted thus reduced availability of light up to middle position of plant. Finally, reduced light availability accelerated elongation of lower internode as well as ears resulting into increased ear length similar results were also reported by Sahoo (1995), Patil (1997), Sharma (1998), Sukanya (1999) and Kailash (2003).

Further despite decrease in number of ear plant$^{-1}$, ear girth and cob weight with husk increased with increased plant densities. This might be on account of higher number of harvestable cobs per unit area under high densities. The higher number of cobs plant$^{-1}$ could not compensate the loss in weight of cob due to less number of harvestable cobs per unit area under lower plant densities.

Higher number of Baby corn plant$^{-1}$ with increased plant densities seems resultant of mutual shading and over crowding of plants. Kailash (2003) also opined similar effects.

Despite marked improvement in performance of individual growth parameters and yield components under 83 K plants ha$^{-1}$ the highest Baby corn yield was recorded under 166 K plants ha$^{-1}$ followed by 333 K plants ha$^{-1}$. This might be on account of higher number of harvestable Baby corn Slight reduction in growth parameters and yield components of Baby corn under higher population might have compensated by higher number of harvestable ears. The positive "r" between Baby corn yield and cob weight with husk ha$^{-1}$ (r = 0.949**) and plant population (r = 0.545**) also substantiated dependence of yield on these components (Table 5.1). Further a unit increase in aforesaid components increased the yield to the magnitude of 0.33 and 0.01 q ha$^{-1}$. The observed relationship is in close agreement with the finding of Pandey (2002) and Kailash (2003) who on the basis of path analysis reported that weight of cobs with husk and plant population directly influenced the Baby corn yield.

Similarly, the highest stover yield under maintenance of 166 K plants ha$^{-1}$ followed by 333 K plants ha$^{-1}$ is due to direct effect of higher plant at harvest. Further, since biological yield is a function of Baby corn yield and stover yield representing reproductive and vegetative growth of the crop. The profound influence of appropriate increased photosynthetic efficiency and nutrient accumulation might have ultimately led to production of higher biological yield under said population density. The result of present investigation indicated higher biological yield under the influence of 83 K and 166 K plant ha$^{-1}$ is in close conformity with findings of Sahoo (1995), Sharma (1998), Pandey (2002) and Allie (2005).

### 5.1.3 Nutrient content and quality

Maintenance of 166 K plants ha$^{-1}$ significantly improved N and P content of ears and fodder, and protein content of ears over its lower population. Similarly, maintenance of 333 K plant ha$^{-1}$ significantly improved moisture and crude protein content of ears compared to lower densities. Alike these, carbohydrate contents and ascorbic acid content of ears also increased with increase in plant densities.

Maintenance of plant population of 166 K plant $ha^{-1}$ increased N and P content of ears which could be possible due to availability of larger space around each plant. Reduced competition resulted in increased prolification and development of root activity and higher extraction of nutrients from the soil. Since most of the nutrients absorbed by the plant during vegetative phase are translocated to developing cobs and finally to green plant. Thus, the higher content of N and P in ears and stover under 166 K plants $ha^{-1}$ was expected. Further increase in population to 333 K plant $ha^{-1}$ caused competition for space as well as growth and prolification of root and therefore reduced nutrient uptake which in turn decreased N and P content of these plant parts. The results are in close conformity with findings of Ameta (1993).

Among plant densities, protein and crude protein content of ears increased significantly under population of 166 K plants $ha^{-1}$ it is well established fact that N and P are essential constituents for synthesis of protein. Under present investigation both of these recorded perceptible improvement in ear with increase in plant densities and findings are in close accordance with that of Ameta (1993) and Kailash (2003).

## 5.2 EFFECT OF FERTILITY LEVELS

### 5.2.1 Growth characters

The results revealed that application of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ significantly improved plant height, dry matter accumulation and stem diameter at various growth stages. At harvest, the magnitude of improvement in dry matter, plant height and stem diameter were to the tune of 1.24 cm and 0.04 g $plant^{-1}$ over 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$. Fertilizer application failed to influence plant population 20 DAS, phonological parameters, LAI and functional leaves.

It is established fact that amongst nutrients N and P are considered to be most important for exploiting genetic potentiality of crop for its growth and development (Tisdale *et al.*, 1995) Nitrogen is considered to be essential constituent required for synthesis of physiological significance in the plant system, whereas, P is involved in better root growth of plants. It also plays an active role in formation of high energy phosphates which are unstable in water and act as carrier for vital reactions like oxidation of sugars through enhancing enzymatic activities and in initial reaction for photosynthesis etc. In fact, it is also considered to be energy currency within the plant system (Kanwar, 1976; Tisdale *et al.*, 1995)

Under the present investigation, the prepondent effect of application of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ on various growth parameters of the crop appears to be on account of enrichment of soil with both these nutrients. The significant improvement in nutrient status of plant parts (ear and fodder) at harvest resulted in better availability of nutrients for growth and development of plant right from early stage, as nutrients in harvestable plant parts and mostly translocated from vegetative to reproductive parts of the plants. Thus better nutritional environment in plants under the influence of increased fertilization seems to have promoted height of plants and growth of individual leaf by way of active cell division and elongation. The larger canopy development and plant height under the application of higher dose of fertilizer might have increased interception, absorption and utilization of radiant energy which in turn increased over all growth, photosynthesis and finally accumulation of dry matter $plant^{-1}$. The significant positive correlation between dry matter accumulation at harvest and plant height (r = 0.244) also validated strong positive "r" between dry matter and plant height (Table 5.1). Further regression analysis indicated strong dependence of dry matter accumulation on plant height as unit increase in plant height improved dry matter accumulation by 17.03 g $plant^{-1}$ (Table 4.3).

The significant improvement in overall growth of the crop under the influence of increased fertilization (N and P) was in the close conformity with findings of Pandey (2000), Mehta (2002) and Kailash (2003).

### 5.2.2 Yield Attributes and Yield

An application of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ significantly improved yield attributing parameters there by recorded significant gain in crop productivity in terns of Baby corn ears, stover and biological yield by 15.63, 13.85 and 14.74 per cent, respectively over 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$. However, further increase in fertilizer dose failed to alter yield, significantly.

The positive response of yield components of Baby corn to fertilizer application could be ascribed to overall improvement in growth of crop as evident from increased plant height, dry matter accumulation and stem diameter. Thus greater accumulation of metabolites and nutrients as evinced from higher dry matter production at silking and at harvest under higher fertilization clearly demonstrate reduced competition of these growth inputs between main shoot and reproductive part consequently increased number of ears, girth and length of ears, weight of ears and cob weight with husk. The regression analysis also revealed dependence of number of ears, ear girth, ear length, weight of ears and cob weight with husk on dry matter accumulation at harvest. The unit increase in dry matter production at harvest increased number of ears (0.001), ear girth (0.004), ear length (0.042), weight of Baby corn ears plant$^{-1}$ (0.37) and cob weight with husk (0.33) (Table 4.4, 4.6 and 4.7).

Positive response of Baby corn yield components to N + $P_2O_5$ fertilization is in close conformity with findings of Sahoo (1999), Thakur (1999), Pandey (2000) and Sharma (2000).

Since, yield of the crop is a function of several yield components which are dependent on complementary interaction between vegetative and reproductive growth of crop. This positive response of higher fertilizer application to both these phases of crop ultimately resulted in realization of higher crop productivity in terms of Baby corn yield. Under present study, estimated interrelationship also validated strong positive 'r' between cob yield and number of ear (r = 0.037), ear length (r = 0.865**), ear girth (r = 0.376), weight of Baby corn ear (r = 0.394) and cob weight with husk (r = 0.949**). Further, regression analysis showed that unit increase in these parameters increased the Baby corn yield by 1.24, 1.53, 5.37, 0.37, 0.33 q ha$^{-1}$, respectively (Table 5.1).

Significant increase in stover yield under the influence of higher fertilizer level appears to be on account of its influence on dry matter production at successive stages and at harvest and indirectly via increase in plant height. The higher biological yield under the influence of application of 90 kg N and 35 kg $P_2O_5$ ha$^{-1}$ could be applied to its positive influence on both vegetative and reproductive growth of the crop which led to increase in Baby corn and stover yield, thereby higher biomass production. The results of present investigation indicated that higher productivity of maize crop under influence of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ are in close conformity with findings of Sharma (1997), Pandey *et al*. (1999), Gaur (2002), Kailash (2003), Paradkar (2004) and Allie (2005).

### 5.2.3 Nutrient content and quality

The analysis of plant parts i.e., ears and stover at crop harvest revealed that an application of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ significantly increased N and P content of ears and stover over 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$. The accumulation of N and P also tended to increase with higher level of fertilizer application (Table 4.9).

The positive influence of fertilizer application in N and P status of plant parts seems to be due to their increased availability from soils. Moreover, higher photosynthetic activity in plants as evident from increase in biomass accumulation at successive duration and plant height reveals higher availability of metabolites from shoot to root. This might have promoted growth of root as well as their functional activity resulting in higher extraction of nutrients from soil environment to aerial plant parts (Table 4.9). The results of the present investigation strongly support findings of Singh (1996), Mehta (2002) and Singh and Totawat (2002)

The analysis of plant parts i.e., ears at harvest of the crop reveals that application of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ significantly increased protein and crude protein content over 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$. Increased protein and crude protein content might be due to increased nitrogen and phosphorus concentration in ears which is integral part of protein synthesis. The result of present investigation indicated higher protein content in ears under the influence of higher N and P fertilization is in close conformity with findings of Yogananda *et al*. (2000) and Singh (2001).

Further with higher availability of N and P the cell become porous and retain higher moisture compared to lower dose. Application of N and P had significant effect on N content of ears. In most of case excess N and water increased the concentration of $NO_3$ in plants, leading to check ascorbic acid formation. In present investigation, ascorbic acid formation was significant but to very marginal level. The results are in close conformity with findings of Mozafar (1993), Singh (1996) and Singh (2001).

## 5.3 ECONOMICS OF TREATMENTS

Maintenance of population of 166 K plants $ha^{-1}$ gives net returns of Rs.25400 $ha^{-1}$ and B:C of 2.00 on account of better availability of nutrients, moisture, solar radiation and space for growth and development. There was more competition within crop community at higher density of 333 K plants $ha^{-1}$ whereas, plant density of 83 K plants $ha^{-1}$ could not contribute to yield on account of less number of plants per unit area.

Maximum net returns of Rs.22070 $ha^{-1}$ was recorded at fertility level of 120 kg N and 40 kg $P_2O_5$ which was significantly higher over 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$ (Rs.14750 $ha^{-1}$) but proved at par with 90 kg N and 35 kg $P_2O_5$ and 180 kg N and 45 kg $P_2O_5$ $ha^{-1}$. However, application of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ proved most economic dose as it recorded highest B:C (1.73). Higher B:C could be possible on account of prevailing cost structure of fertilizers.

# SUMMARY AND CONCLUSION

The field experiment entitled “Effect of Plant Population and Fertility Levels on yield and Quality of Baby corn (*Zea mays* L.)” was conducted during *kharif* 2005 at the Instructional Farm, Rajasthan College of Agriculture, Udaipur. The results presented and discussed in the preceeding chapter are summarized below:

**6.1 EFFECT OF PLANT POPULATOION**

- Plant population of Baby corn both 20 DAS and at harvest increase significantly with increase in plant population up to 333 K plants ha$^{-1}$.
- Plants population at varying densities from 83 K to 333 K plants ha$^{-1}$ did not influence various phenological parameters.
- Maximum dry matter accumulation was recorded at 83 K plants ha$^{-1}$ which was significantly higher over 111 K plants ha$^{-1}$. However found at par with 166 K and 333 K plant ha$^{-1}$.
- Highest plant height was recorded under 333 K plants ha$^{-1}$, which was found at par with 166 K plants ha$^{-1}$ but significantly higher over 111 K and 83 K plants ha$^{-1}$.
- Highest LAI was recorded at 333 K plants ha$^{-1}$ which was significantly higher over 166 K, 111 K and 83 K plants ha$^{-1}$ 40 DAS and at harvest.
- Crop under varying population densities failed to show significant variation in functional leaves plant-$^{1}$.
- Highest stem diameter was recorded at 83 K plants ha$^{-1}$ which was significantly higher over 111 K, 166 K and 333 K plant ha$^{-1}$.
- Maximum number of ears plant$^{-1}$, ear girth and weight of ears (dry and wet) were recorded under lower plant density viz., 83 K plant ha$^{-1}$. Increase in plant densities decreases these parameters. Contrary to this length of ears decreases with increase in plant densities.
- Increase in plant densities from 83 K to 333 K plant ha$^{-1}$ increase barrenness of plant significantly.
- Cob weight with husk increase significantly up to 166 K plants ha$^{-1}$. Further increase in plant density though increase cob weight with husk, however failed to record statistical significance.

- Maintenance of 166 K plant $ha^{-1}$ significantly increased Baby corn, green fodder and biological yield over 111 K and 83 K plant $ha^{-1}$. Further increase in plant population marginally decreases these parameters compared to 166 K plants $ha^{-1}$.
- Highest moisture content of ears was recorded under population of 333K plants $ha^{-1}$ which was found significantly higher over 166K, 111K and 83K plants $ha^{-1}$. Where as maintenance of 166K plants $ha^{-1}$ recorded highest protein and carbohydrate content of ears. Further increase in plant population decrease protein and carbohydrate content of ears marginally. Increase in plant population from 83K to 111K plant $ha^{-1}$ increase ascorbic acid content of ears significantly. Further increase in plant population up to 333K plants $ha^{-1}$ failed to influence ascorbic acid content of ears.
- Maintenance of 333K plants $ha^{-1}$ yielded maximum crude protein content in fodder over 166K, 111K and 83K plants $ha^{-1}$.
- Nitrogen content of ears and fodder was maximum at 166K plants $ha^{-1}$ which was found at par with lower population of 111K but proved significantly superior over 83K and 333K plants $ha^{-1}$.
- Phosphorus content of ears and fodder was maximum at 166K plants $ha^{-1}$which was significantly higher over 333K, 111K and 83K plant $ha^{-1}$.
- Plant population failed to influence N and P content of soil estimated after harvest of crop significantly.
- Maintenance of 166K plants $ha^{-1}$ proved most economic level of plant density as it recorded significantly higher net returns over 333K, 111K and 83K plants $ha^{-1}$ by Rs.5180, Rs.6160, Rs.10860, respectively and also fetched higher B:C (2.00) compared to B:C of 1.43, 1.63 and 1.29 recorded under 333 K, 111 K and 83 K plants $ha^{-1}$.

## 6.2 EFFECT OF FERTILITY LEVELS

- Increasing rate of fertilizer application up to 180 kg N and 45 kg $P_2O_5$ did not influence plant stand significantly recorded 20 DAS and at harvest.

- Crop under varying fertility levels failed to show perceptible variation in days to 50% silking, days to 50% tasselling and days to harvest initiation.
- Highest LAI was recorded under maintenance of 333K plants $ha^{-1}$ which was significantly higher over its lower population viz., 166K, 111K and 83K $ha^{-1}$ at both the stages of plant growth. Contrary to this stem diameter decrease significantly with increase in plant densities from 83 K to 333 K plants $ha^{-1}$.
- Fertilizer level failed to record perceptible variation in functional leaves $plant^{-1}$.
- Application of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ recorded significantly number of ears $plant^{-1}$, ear length, ear girth, fresh and dry weight of ear by 7.96, 14.61, 10.00, 16.72 and 16.60 per cent, respectively over 60 kg N and 30 kg $P_2O_5$. Further increase in N and P dose though improved all these characters but failed to record statistical significance.
- Number of barren plants $ha^{-1}$were least at highest fertility level (180 kg N and 45 kg $P_2O_5$ $ha^{-1}$) and increases with decreasing fertilizer doses.
- Application of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ significantly enhanced cob weight with husk by 16.45 per cent over 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$ further increase in fertilizer doses improved weight of cob but proved statistically at par.
- Baby corn, green fodder and biological yield was highest at 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ by 20.52, 22.25 and 21.10 per cent over 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$, respectively. Further increase in fertilizer dose were found statistically at par with 120 kg N and 40 kg $P_2O_5$ $ha^{-1}$ and 180 kg N and 45 kg $P_2O_5$ $ha^{-1}$.
- Highest moisture and protein content were recorded under application of 120 kg N and 40 kg $P_2O_5$ $ha^{-1}$. Further increase in fertilizer dose though decreases moisture and protein content but failed to record statistical significance.
- An application of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ enhanced carbohydrate content by 3.34 per cent over 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$, further increase in fertilizer levels enhanced carbohydrate content but failed to record statistical superiority.
- Fertilizer levels failed to record significant variation in ascorbic acid content of ears.

- An application of 180 kg N and 45 kg $P_2O_5$ $ha^{-1}$ significantly enhanced crude protein content of fodder over lower fertilizer doses.
- Nitrogen content of ears and fodder was found significantly higher at fertility level of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ over 60 kg N and 30 kg $P_2O_5$ further increase in doses of N and P and was found at par.
- Fertility levels showed no perceptible variation in recorded P content of ears. However, highest P content of Baby corn fodder was recorded under application of 120 kg N and 40 kg $P_2O_5$ $ha^{-1}$ which was found at par with 180 kg N and 45 kg $P_2O_5$ $ha^{-1}$ and 90 kg and 35 kg $P_2O_5$ $ha^{-1}$ but proved significantly higher over 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$ .
- Fertility levels failed to record significant influence on N and P content of soil estimated after harvest of Baby corn.
- Highest net returns Rs.22070 $ha^{-1}$ was recorded under application of 120 kg N and 40 kg $P_2O_5$ $ha^{-1}$ which was significantly higher over 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$ by Rs.7320 $P_2O_5$ $ha^{-1}$ but proved at par with 90 kg and 35 kg $ha^{-1}$ and 180 kg N and 45 kg $P_2O_5$ $ha^{-1}$. However, application of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ proved most economic dose as it recorded highest B:C (1.73) followed by 1.68, 1.63 and 1.31 recorded under 180 kg N and 45 kg $P_2O_5$ $ha^{-1}$, 120 kg N and 40 kg $P_2O_5$ $ha^{-1}$and 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$.

*On the basis of the results emanated from present investigation conducted during Kharif 2005, it is concluded that under prevailing agro climatic conditions in zone IVa of Rajasthan production of Baby corn can be substantially increased by growing at plant population of 166 K plants $ha^{-1}$ (60 x 10 cm). It is most suitable crop geometry for Baby corn production.*

*Highest net returns Rs.22070 $ha^{-1}$ was recorded under the application of 120 kg N and 40 kg $P_2O_5$ $ha^{-1}$ which was significantly higher over 60 kg N and 30 kg $P_2O_5$ and by Rs.14750 $ha^{-1}$ but proved at par with 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$and 180 kg N and 45 kg $P_2O_5$ $ha^{-1}$. However, an application of 90 kg N and 35 kg $P_2O_5$ $ha^{-1}$ proved most economic does as it recorded highest B:C of 1.73 followed by 1.63, 1.68 and 1.31 recorded under 180 kg N and 45 kg $P_2O_5$ $ha^{-1}$, 120 kg N and 40 kg $P_2O_5$ $ha^{-1}$ and 60 kg N and 30 kg $P_2O_5$ $ha^{-1}$, respectively*

# LITERATURE CITED


A.O.A.C. 1975. Official method of analysis, 12th Edition Association of Official Analytical Chemists, Washington.

Ahmedi, M. 1990. Cultural practices and endosperm effects on corn Kernel chemical and physical properties. Dissertation Abstract, *International Journal of Science and Engineering* 51:564-578.

Allie, 2005. Effect of N levels and plant spacing on performance of Baby corn. Annual Report, AICMIP, Directorate of Maize Research, New Delhi, A 87.

Ameta, G.S. 1993. Response of winter maize (*Zea mays* L.) to nitrogen fertilization in relation to varying population density and row spacing. Ph.D. Thesis, Department of Agronomy, Udaipur, Rajasthan Agricultural University, Bikaner.

Aulakh, K.S. 1998. Effect of spacing on Baby corn experiment during *kharif* 1998. Annual Progress Report, AICMIP, Directorate of Maize Research, New Delhi, A-35.

Black, C.A. 1965. Method of soil analysis. *American Society* of *Agronomy*, Madison, Wisconsin, USA.

Bouyoucous, G.J. 1962. Hydrometer method for particle size analysis of soil *Agromet.*, 55:464-465.

Brady, N.C. 1983. The nature and properties of soils, Macmillan Publishing Co, New York and Colliar McMillan Publisher, London, pp.750.

Choudhary, J. 2005. Effect of Plant Population and fertility levels on yield and Quality of Pop corn (*Zea mays* L. Everta), M.Sc. (Ag.) Thesis, Department of Agronomy, Maharana Pratap University of Agriculture and Technology, Udaipur.

Cocharan, W.G. and Cox, G.M. 1967. Experimental designs. II Edition, John Willey and Sons Inc., New York.

Donald, C.M. 1963. Competition among crops and pasture plants. *Advances in Agronomy,* 15:1-18.

Gaur, B.L. 2002. Effect of cultivar, nitrogen, phosphorus and plant population on Baby corn productivity. *Haryana Journal of Agronomy* 18:159-160.

Gaur, B.L., Mansion, P.R. and Gupta, D.C.1992. Effect of nitrogen levels and their splits on yield of winter maize (*Zea mays L.*) *Indian Journal of Agronomy*, 37: 816-817.

Hodge, J.E. and Hofreiter, B.T. 1962. *In* : Methods in Carbohydrate Chemistry (eds. N. Histler and Be Miller, J.N.). Academic press, New York.

Hozumi, K., Koyami, H. and Kira, T. 1955. Inter specific competition among higher plants. IV. A preliminary account of interaction between adjacent individuals. *Journal of Institutional Polytechnics, Osaka City University,* Ser.D6, 121-130.

Jackson, M.L. 1973. Soil chemical analysis. Prentice Hall of India inc., Englewood cliffs, New Jersey.

Kanwar, J.S. 1976. Soil fertility, theory and practices. ICAR Pub. New Delhi, pp.19-32.

Lindner, R.C. 1944. Rapid analytical methods of some for more common organic substances of plant and soil. *Plant Physiology*, 19:76-84.

Massey, J.X.2005. Effect of plant population and fertility levels on yield and quality of Sweet corn (*Zea mays L.*) Cultivars, M.Sc. (Ag.) Thesis, Department of Agronomy, Maharana Pratap University of Agriculture and Technology, Udaipur.

Meena , O.P. 2000. Effect of nitrogen and plant population on performance of maize (*Zea mays* L.) varieties for green cob during summer. M.Sc. (Ag.) Thesis, Department of Agronomy, Maharana Pratap University of Agriculture and Technology, Udaipur.

Mehta, Y.K. 2002. Effec of sulphur, phosphorus and FYM on productivity of maize (*Zea mays* L.) and their residual effect on mustard [*Brassica juncea* (L.) Czern

& Coss.] at varying fertility levels. Ph.D Thesis, Department of Agronomy, Maharana Pratap University of Agriculture and Technology, Udaipur.

Mozafar, A. 1993. Nitrogen fertilizers and the amount of vitamins in plants : A review *Journal of Plant Nutrition*, 16:2479-2506.

Olsen. S.R., Cole, C.W., Wathade, F.S. and Dean, L.A. 1954. Estimation of available phosphorus in soil by extraction with $NAHCO_3$. *USDA Cir.* No.959, Washington, P.13.

Pandey A.K. 1997. Selection of suitable variety and optimum plant population for Baby corn production at Almora. Annual Progress Report, AICMIP, Directorate of Maize Research, New Delhi, A 48-99.

Pandey A.K., Prakash, V., Mani, V.P. and Singh, R.D. 2000. Effect of rate of nitrogen and time of application on yield and economics of Baby corn (Zea mays). *Indian Journal of Agronomy*, 45:338-343.

Pandey, A.K. 1995. Suitable varieties and optimum plant population for Baby corn production at Almora. Annual Progress Report, AICMIP, Directorate of Maize Research, New Delhi, A 57.

Pandey, A.K. 1997. Response of nitrogen rates and N scheduling for Baby corn production at Alomra. Annual Progress Report AICMIP, Directorate of Maize Research, New Delhi, A 40-41.

Pandey, A.K. 1998. Response of scheduling N on Baby corn production at Almora. Forty First Annual Progress Report, AICMIP, Directorate of Maize Research, New Delhi, A 30

Pandey, A.k. 2001. Effect of planting geometries and N levels on Baby corn and French bear (Vegetable) intercropping system at Almora. Forty Fourth Annual Progress Report, AICMIP, Directorate of Maize Research, New Delhi, A 64.

Pandey, A.K., Mani, P., Chauhan, V.S and Singh, R.D. 1999. Effect of plant population, row spacing and nitrogen level on the extra early composite-VL Makka 88 under midhills of Himalayas. *Journal of Hisar Research*, 12:88-91.

Pandey, A.K., Mani, V.P., Prakash, V., Singh, R.D. and Gupta, H.S. 2002. Effect of varieties and plant densities on yield, yield attributes and economics of Baby corn (*Zea mays*). *Indian Journal of Agronomy*, 47:221-226.

Panse, V.G. and Sukhatme, P.V. 1985. Statistical methods for agricultural works, ICAR, New Delhi.

Paradkar, V.K. 2004. Effect of N levels and plant spacing on performance of Baby corn at Chindwara, Annual Progress Report, Directorate of Maize Research, IARI, New Delhi, A 77.

Paradkar, V.K. 2005. Agro-technology for speciality corn (Baby corn). Annual Progress Report, AICMIP, Directorate of Maize Research, New Delhi, A-87.

Paroda, S. 1994 Thailand mein Baby corn ki safalta kheti. *Kheti,* 48:15-81, 21.

Patel, G.J. and Patel, G.N. 2002. Effect of densities and date of thinning on productivity of maize (*Zea mays* L.) Annual Progress Report, AICMIP, Agronomy Unit, New Delhi, pp.5-10.

Patil, S.J. 1997. Agronomic investigation in Baby corn at Arbhavi. Annual Progress Report Report, AICMIP, Directorate of Maize Research, New Delhi, A 58-59.

Piper, C.S. 1950. Soil and Plant Analysis. Inter Science Publisher Inc., New York.

Raja, V.2001. Effect of nitrogen and plant population on yield and quality of super sweet corn (*Zea mays* L.). *Indian Journal of Agronomy* 46 : 246-249.

Richard, L.A. 1968. Diagnosis and improvemtn of saline and alkali soils. USDA Hand Book No.60, Oxford and IBH Pub. Co., New Delhi.

Sadasivam, S. and Theymoli, B. 1987. *In*: Practical Manual in Biochemistry, Tamil Nadu Agricultural University, Coimbatore, pp.114.

Sahoo, S.C. 1995. Determination of optimum plant geometry for Baby corn at Jashipur. Annual Progress Reprt, AICMIP, Directorate of Maize Research, New Delhi, A 50.

Sahoo, S.C. 2001. Response of maize varieties to N levels for Baby corn Production at Jaipur. Annual Rabi Maize Progress Report, AICMIP, Directorate of Maize Research, New Delhi. A 29.

Sahoo, S.C. and Panda, M.M. 1999. Effect of levels of nitrogen and plant population on yield of Baby corn (*Zea mays L.*). *Indian Journal of Agricultural Sciences,* 69:157-158.

Sahoo, S.C. and Panda, M.M. 2001. Effect of phosphorus on yield of Baby corn (Zea mays L.) *Indian Journal of Agricultural Science*, 71 :21-22.

School, S.C. and Panda, M.M. 1997, Fertilizer requirement of Baby corn (Zea mays) in wet and winter seasons. *Indian Journal of Agricultural Sciences*, 67:397-398

Sen, A., Sharma, S.N., Singh, A.K. and Pal, A.K. 1999. Effect of fertility level and plant spacing on the performance of maize inbred parental line-CM11 in the rainy season. *Indian Journal of Agronomy*, 15:10-14.

Sharma, G., Saikia, R.B and Sharma, G. 2000. Stability analysis for yield and yield attributing characters in Baby corn (*Zea mays* L.). *Indian Journal of Hill Farming*, 13:1-2.

Sharma, R.K. 1997. Baby corn experiment at Ludhiana. Annual Progress Report AICMIP, Directorate of Maize Research, New Delhi, A 45-46.

Sharma, R.K. 1998. Baby corn experiment at Ludhiana. Annual Progress Report, AICMIP, Directorate of Maize Research, New Delhi, A 35.

Sharma, R.K. 2001. Effect of spacing on yield of Baby corn at Ludhiana. Forty Fourth Annual Progress Report AICMIP, Directorate of Maize Research, New Delhi, A 73.

Singh, A. 1996. Response of maize to zinc application at varying nitrogen level. M.Sc. (Ag) Thesis, Department of Agronomy, Rajasthan College of Agriculture, Udaipur, Rajasthan Agricultural University, Bikaner.

Singh, A.K., Singh, G.R. and Dixit, R.S. 1997. Influence of plant population and moisture regimes on nutrient uptake and quality of winter maize (*Zea mays* L.) *Indian Journal of Agronomy*, 41:107-111.

Singh, G. 1990. Studies on intercropping and nitrogen management in maize-wheat crop sequence. Ph.D. (Ag.) Thesis, Department of Agronomy, Rajasthan Agriculture University, Bikaner.

Singh, K.K. Fazeel, A. and Gautam, R.C. 1996. Response of maize to nitrogen and percentage of taxed removal. *Annals of Agricultural Research*, 17:213-214.

Singh, R. and Totawat, K.L. 2002. Effect of integrated use of nitrogen on the performance of maize (*Zea mays* L.) on haplustalfs of the sub-humid southern plains of Rajasthan. *Indian Journal of Agricultural Research,* 36:102-107.

Singh, S.D. 2001. Effect of irrigation regimes and nitrogen levels on growth, yield and quality of Baby corn, *Madras Agricultural Journal*, 88:371-374.

Singh, S.P. 1991. Response of different maturing maize (Zea mays L.) cultivars to nitrogen levels and stand geometry. M.Sc.(Ag.) Thesis, Department of Agronomy, Rajasthan Agriculture University, Bikaner.

Subbiah, B.V. and Asija, G.L. 1956. A rapid procedure for the estimation of available nitrogen in soils : *Current Science,* 27:259-260.

Sukanya, T.S., Nanjappa, H.V. and Ramchandrappa, B.K. 1999. Effect of spacing in the growth, development and yield of Baby corn (*Zea mays* L.) varieties. *Karnataka Journal of Agricultural Sciences,* 12:10-14.

Thakur, D.R. 1997. Studies on Phosphorus and Potassium requirements in Baby corn at Bajaura. Annual Progress Report, AICMIP, Directorate of Maize Research, New Delhi, A 54.

Thakur, D.R. 1998. Studying the effect of P and K on Baby corn production at Bajaura. Annual Progress Report, AICMIP, Directorate of Maize Research, New Delhi, A 46.

Thakur, D.R. and Sharma, V. 1999. Effect of varying rates of nitrogen and its schedule of split application in Baby corn (*Zea mays* L.). *Indian Journal of Agricultural Science*, 69:93-95.

Thakur, D.R., Om, P., Kharwara, P.C. and Bhalla, S.K. 1997. Effect of nitrogen and plant spacing on growth, yield and economics of Baby corn (*Zea mays*). *Indian Journal of Agronomy,* 42:479-483.

Thakur, D.R., Om, P., Kharwara, P.C. and Bhalla, S.K. 1998. Effect of nitrogen and plant spacing on yield, nitrogen uptake and economic in Baby corn (*Zea mays* L.). *Indian Journal of Agronomy,* 43:668-671.

Tisdale, S.L., Nelson, W.L., Beaton, J.D. and Havlin, J.L. 1995. Soil fertility and fertilizer. 5th Edition, Prentice Hall of India Pvt. Ltd., New Delhi.

Tsen C.C. and Martin E.E. 1971. A note on determining protein contents in various wheat flours and flour stream by Kjeldahi and by neutron activation methods. *Cereal Chemistry*, 48:721-726.

Tyagi, R.C., Singh, D., Hooda, I.S. and Singh, D. 1998. Effect of plant population, irrigation and nitrogen on yield and its attributes of maize (*Zea mays*).*Indian Journal of Agronomy,* 43:62-676.

Vipawon, A. and Anophi, C. 1985. Effects of plant density on yield and quality of sweet corn seeds. *Raingan Khonkhwa Whichai prachami* 2528:41-42.

Walkley, A.and Black, I.A. 1947. A rapid procedure for the estimation of available nitrogen in soils. *Current science*, 27:259-260.

Yoganda, S.B., Shivaraj, B., Andani, G.K.N. and Gowda, A. 2000. Effect of plant population, phosphorus and potassium levels on yield and quality of pop corn. *Current Research*, 29:92-94.

*However, these results are only indicative based on year experimentation thus before any recommendations further confirmation is required.*