Growth and Productivity of Winter Maize (Zea mays L.) Under Different Levels of Nitrogen and Plant Population

Jiban Shrestha

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ACKNOWLEDGEMENT

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Jiban Shrestha
TABLE OF CONTENTS

Content

AKNOWLEDGEMENT
TABLE OF CONTENTS
LISTS OF TABLES
LIST OF FIGURES
LIST OF APPENDICES
ACRONYMS AND ABBREVIATIONS
ABSTRACT IN ENGLISH
ABSTRACT IN NEPALI
1 INTRODUCTION
2 LITERATURE REVIEW
  2.1 Economic and nutritional values of maize
  2.2 Area, production and productivity of maize
  2.3 Factors associated with low yield of maize
  2.4 Current practices related to nitrogen and plant density
  2.5 Response of maize to growing season
  2.6 Role of nitrogen in maize
  2.7 Time and methods of nitrogen application in maize
  2.8 Effect of nitrogen on growth of maize
  2.9 Effect of nitrogen on yield and yield components of maize
  2.10 Factors affecting optimum plant density
  2.11 Stress mechanism of plant population
  2.12 Plant architecture associated with tolerance to high plant densities
  2.13 Effect of plant densities on growth of maize
2.14 Effect of plant densities on grain yield and yield components of maize

2.15 Interaction effect of nitrogen and plant densities on maize

2.16 Grain nitrogen uptake

3 MATERIALS AND METHODS

3.1 Site description

3.2 Meteorological data during crop season

3.3 Soil characters

3.4 Treatment and experimental details

3.5 Cultural practices

3.5.1 Land preparation

3.5.2 Manure and fertilizer application

3.5.3 Seed sowing

3.5.4 Irrigation

3.5.5 Weeding and earthing up

3.5.6 Plant protection

3.5.7 Harvesting and threshing

3.6 Measurement of growth attributes

3.6.1 Plant height

3.6.2 Stem diameter

3.6.3 Number of leaves/plant

3.6.4 Leaf area index

3.6.5 Total dry weight

3.7 Phenological observations

3.7.1 Days to 75% tasseling
3.7.2 Days to 75% silking
3.7.3 Days to 75% physiological maturity

3.8 Measurement of yield attributes
3.8.1 Number of plants at harvest
3.8.2 Number of barren plants
3.8.3 Number of cobs/plant
3.8.4 Cob length
3.8.5 Cob diameter
3.8.6 Number of grain rows/cob
3.8.7 Number of grains/grain row
3.8.8 Number of grains/cob
3.8.9 Test weight

3.9 Measurement of yield
3.9.1 Grain yield
3.9.2 Stover yield
3.9.3 Grain: stover ratio
3.9.4 Shelling recovery
3.9.5 Harvest index

3.10 Grain nitrogen uptake

3.11 Economic analysis
3.11.1 Cost of cultivation
3.11.2 Gross return
3.11.3 Net return
3.11.4 Benefit: cost ratio

3.12 Statistical analysis
4 RESULTS AND DISCUSSION

4.1 Growth attributes

4.1.1 Plant height
4.1.2 Stem diameter
4.1.3 Number of leaves/plant
4.1.4 Leaf area index
4.1.5 Above ground dry matter

4.2 Phenological observations

4.2.1 Days to tasseling
4.2.2 Days to silking
4.2.3 Days to physiological maturity

4.3 Yield attributes

4.3.1 Number of plants at harvest and number of cobs/plant
4.3.2 Cob length
4.3.3 Cob diameter
4.3.4 Number of grains/grain row
4.3.5 Number of grain rows/cob
4.3.6 Number of grains/cob
4.3.7 Test weight and shelling recovery

4.4 Yield data

4.4.1 Grain yield
4.4.2 Stover yield
4.4.3 Grain: stover ratio and harvest index

4.5 Relationship between grain yield and yield components of maize

4.6 Number of barren plants
4.7 Grain nitrogen uptake

4.8. Economic analysis

5 SUMMARY AND CONCLUSION

6 LITERATURE CITED

APPENDICES

BIOGRAPHICAL SKETCH
LIST OF TABLES

Table
1  Mechanical and chemical analyses of soil for maize research at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.
2  Combinations of treatments for maize research at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.
3  Effect of different nitrogen levels and plant densities on plant height of maize at 30, 60 and 90 DAS at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.
4  Effect of different nitrogen levels and plant densities on stem diameter of maize at 30, 60 and 90 DAS at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.
5  Effect of different nitrogen levels and plant densities on number of leaves/plant of maize at 30, 60 and 90 DAS at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.
6  Effect of different nitrogen levels and plant densities on leaf area index of maize at 30, 60 and 90 DAS at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.
7  Effect of different nitrogen levels and plant densities on dry matter yield of maize at 30, 60 and 90 DAS at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.
8  Interaction between different nitrogen levels and plant densities on dry matter yield of maize at 30, 60 and 90 DAS at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.
Effect of different nitrogen levels and plant densities on phenology of maize at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

Interaction between different nitrogen levels and plant densities on days to physiological maturity of maize (DAS) at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

Effect of different nitrogen levels and plant densities on number of plants/ha at harvest and number of cobs/plant of maize at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

Interaction between different nitrogen levels and plant densities on number of cobs/plant of maize at Anandapur, Mangalpur V.D.C-3, Chitwan, 2006/07.

Effect of different nitrogen levels and plant densities on yield components of maize at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

Effect of different nitrogen levels and plant densities on test weight and shelling recovery (%) of maize at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

Effect of different nitrogen levels and plant densities on grain yield of maize at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

Interaction between different nitrogen levels and plant densities on grain yield (kg/ha) of maize at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

Effect of different nitrogen levels and plant densities on stover yield of maize at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

Interaction between different nitrogen levels and plant densities on
stover yield of maize (kg/ha) at Anadapur, Mangalpur VDC-3, Chitwan, 2006/07.

19 Effect of different nitrogen levels and plant densities on grain: stover ratio and harvest index at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

20 Effect of different nitrogen levels and plant densities on number of barren plants/ha and barrenness (%) in maize at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

21 Effect of different nitrogen levels and plant densities on grain nitrogen uptake by maize at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

22 Economics of maize production through different nitrogen levels and plant densities at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

23 Interaction between different nitrogen levels and plant densities on economics of maize production at Anadapur, Mangalpur VDC-3, Chitwan, 2006/07.
LIST OF FIGURES

Figure
1 Weather data during the growing period of maize at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.
2 Design of each experimental plot for maize research at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.
3 Layout of experimental field for maize research at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.
4 Effect of different nitrogen levels on leaf area index (LAI) of maize at 30, 60 and 90 DAS at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.
5 Effect of different plant densities on leaf area index (LAI) of maize at 30, 60 and 90 DAS at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.
6 Effect of different nitrogen levels on dry matter yield of maize at 30, 60 and 90 DAS at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.
7 Effect of different plant densities on dry matter yield of maize at 30, 60 and 90 DAS at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.
8 Relationship between different nitrogen levels and grain yield of Zea mays L. at maize at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.
LIST OF APPENDICES

Appendix


2. Rating chart of soil values to determine the fertility of soil.


4. Mean squares from ANOVA for plant heights of maize at 30, 60 and 90 DAS at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

5. Mean squares from ANOVA for stem diameters of maize at 30, 60 and 90 DAS at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

6. Mean squares from ANOVA for number of leaves/plant maize at 30, 60 and 90 DAS at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

7. Mean squares from ANOVA for Leaf area index (LAI) of maize at 30, 60 and 90 DAS at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

8. Mean squares from ANOVA for dry matter yield of maize at 30, 60 and 90 DAS at Anandapur, Mangalpur VDC-3, Chitwan,
9 Mean squares from ANOVA for days to tasseling, silking and physiological maturity of maize at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

10 Mean squares from ANOVA for number of plants/ha, number of cobs/plant, cob diameter and cob length of maize at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

11 Mean squares from ANOVA for number of grains/grain row, number of grain rows/cob and number of grains/cob of maize at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

12 Mean squares from ANOVA for grain yield, stover yield, grain:stover ratio and harvest index of maize at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

13 Mean squares from ANOVA for number of shelling recovery (%) and test weight of maize at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

14 Mean squares from ANOVA for grain nitrogen uptake at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

15 Mean squares from ANOVA for number of barren plants/ha and barrenness (%) of maize at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

16 Mean squares from ANOVA for gross return, net return and benefit: cost ratio of maize production at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.
17 General cultivation cost of maize at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

18 Variable cost of different nitrogen levels imposed on maize at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

19 Variable cost of different plant densities imposed on maize at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

20 Treatment wise cultivation cost of maize at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

21 Chemical fertilizers and manure used/plot in maize at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

22 Average composition of fertilizer materials used in maize at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

23 Assessment of relationship between grain yield and yield components of maize through linear regression analysis in response to different nitrogen levels at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.

24 Correlation between yield and yield attributing components of maize in response to different nitrogen levels at Anandapur, Mangalpur VDC-3, Chitwan, 2006/07.
ACRONYMS AND ABBREVIATIONS

@ At the rate of
a. i. Active ingredient
ANOVA Analysis of variance
B:C ratio Benefit: cost ratio
CIMMYT Centro Internacional de Mejoramiento de Maiz y Trigo
cm Centimeter
cm² Square centimeter
CV Coefficient of variation
°C Degree centigrade
DAS Days after sowing
DMRT Duncan’s Multiple Range Test
FAO Food and Agriculture Organization
eds Edited
et al. et alii
g Gram
ha Hectare
IAAS Institute of Agriculture and Animal Science
i. e. That is
kg Kilogram
kg/ha Kilogram/hectare
km Kilometer
K₂O Potassium
<table>
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<tr>
<th>Abbreviation</th>
<th>Definition</th>
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<tr>
<td>LAI</td>
<td>Leaf area index</td>
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<tr>
<td>lit</td>
<td>Liter</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>Least significance difference (at 5% level)</td>
</tr>
<tr>
<td>m</td>
<td>Meter</td>
</tr>
<tr>
<td>m²</td>
<td>Meter square</td>
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<tr>
<td>Max</td>
<td>Maximum</td>
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<tr>
<td>Min</td>
<td>Minimum</td>
</tr>
<tr>
<td>ml</td>
<td>Milliliter</td>
</tr>
<tr>
<td>mm</td>
<td>Millimeter</td>
</tr>
<tr>
<td>MOAC</td>
<td>Ministry of Agriculture and Co-operatives</td>
</tr>
<tr>
<td>mt</td>
<td>Metric ton</td>
</tr>
<tr>
<td>N</td>
<td>Nitrogen</td>
</tr>
<tr>
<td>NS</td>
<td>Non significant</td>
</tr>
<tr>
<td>NARC</td>
<td>Nepal Agriculture Research Council</td>
</tr>
<tr>
<td>NMRP</td>
<td>National Maize Research Program</td>
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<tr>
<td>P₂O</td>
<td>Phosphorous</td>
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<tr>
<td>SEM</td>
<td>Standard error mean</td>
</tr>
<tr>
<td>SINA</td>
<td>Statistical Information on Nepalese Agriculture</td>
</tr>
<tr>
<td>RH</td>
<td>Relative humidity</td>
</tr>
<tr>
<td>RCBD</td>
<td>Randomized Complete Block Design</td>
</tr>
<tr>
<td>Rs.</td>
<td>Rupees</td>
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<tr>
<td>t/ha</td>
<td>Ton per hectare</td>
</tr>
<tr>
<td>VDC</td>
<td>Village Development Committee</td>
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<td>Wt.</td>
<td>Weight</td>
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< Lesser than
>
Greater than

π Pai
ABSTRACT

Name: Jiban Shrestha
Semester and year of admission: First, 2005        Id. No.: R-2005-AGR-04M
Major Subject: Agronomy                                    Degree: Master of Science in Agriculture
Major Advisor: Prof. Deo Nath Yadav, Ph.D.      Department: Agronomy

A field experiment was conducted at farmer’s field of Anandapur, Mangalpur VDC-3, Chitwan, Nepal during winter season from September 2006 to February 2007 to study the effects of nitrogen and plant population on maize. Fifteen treatment combinations consisting of five levels of nitrogen: 0, 50, 100, 150 and 200 kg N/ha and three levels of plant population; 55555 plants/ha (60 cm × 30 cm spacing), 66666 plants/ha (60 cm × 25 cm spacing) and 83333 plants/ha (60 cm × 20 cm spacing) were tested in factorial randomized complete block design (RCBD) with 3 replications. “Rampur Composite” variety of maize was planted on sandy silt loam and strongly acidic soil having medium in total nitrogen (0.123%), high in soil available phosphorous (77.56 kg/ha) and low in soil available potassium (23.25 kg/ha). The research findings revealed that each level of nitrogen significantly increased grain yield upto 200 kg N/ha. The grain yield (6514.48 kg/ha) obtained under 200 kg N/ha was significantly higher than that of 0, 50, 100 and 150 kg N/ha. The percent increment in yield due to application of 50, 100, 150 and 200 kg N/ha was to the extent of 62.11, 104.74, 135.68 and 154.74%, respectively over control. Significant effect on grain yield due to different levels of plant population was observed. The grain yield (5113.46 kg/ha) obtained under 66666 plants/ha was statistically at par with that under 83333 plants/ha, but significantly superior over that under 55555 plants/ha. The interaction between different nitrogen levels and plant densities on grain yield showed that the highest grain yield (6925.79 kg/ha) was obtained under treatment of 200 kg N/ha + 66666 plants/ha. The yield attributes namely number of cobs/plant, cob length, cob diameter, number of grain rows/cob and 1000 seed weight significantly increased with increasing N levels and decreasing plant
The number of barren plants/ha decreased with increasing levels of N but increased with increasing levels of plant population. The net return (Rs. 42188.74/ha) and benefit:cost ratio (1.67) obtained under 200 kg N/ha were significantly highest than that obtained under other levels of nitrogen (150, 100, 50 and 0 kg N/ha). The plant population of 66666 plants/ha gave the highest net returns (Rs. 25812.28) which was 10.19 and 49.64% higher than that of 83333 plants/ha and 55555 plants/ha, respectively. The benefit: cost ratio (1.44) obtained under 66666 plants/ha was significantly higher than that of 55555 and 83333 plants/ha. The interaction between different nitrogen levels and plant densities on economics of maize production showed that significantly highest net return (Rs.48606.98) and B:C ratio (1.78) were under treatment of 200 kg N/ha + 66666 plants/ha. The highest grain yield and maximum profit were obtained when maize variety “Rampur Composite” was planted with 200 kg N/ha and plant population level of 66666 plants/ha (60 cm × 25 cm spacing).
शोधसार

नाम: जीवन भेल
मञ्च तथा भागी मित्र प्रथम, २०६२
मुख्य विषय: वाली विज्ञान
मुख्य सलाहकार: प्रा. डा. देवनाथ यादव

मराठपुर गा.वि.स.बडा न.-२, आनंदपुर, नितायगाम मध्ये वाली उपाध्यक्षता नाडुङ्जन मत र वाली धनवचक उपजित मात्रा पता लगायन २०६२ आखिरकार देखि २०६३ मध्ये समग्र हिंदुस्तान एक परिश्रम गरिएको थियो। उक्त परिश्रम वाढौट प्रदर्शक, वर्मी, मध्यम नाडुङ्जन (0.925 %), उच्च फर्स्टकोर्स (७५.५५ क्र० क्र०, प्रति हेक्टर) र न्यून पाटालसिम (३२.५२ क्र० क्र०, प्रति हेक्टर) भएको मानवीय फ्लाक्टिअशन, सन्तोषांशक कमेंटॅट व्यक्तित्व विज्ञानमा तीन फटक दोहराया गरिएको थियो। सो परिश्रम रक्षा गर्ने जात ‘रामपुर कम्युनिटी’ लाई विशेषतः पाँच वटा नाडुङ्जन मलको मात्रा: ०, २०, १००, १२० तथा २०० क्र० क्र०, प्रति हेक्टर र तीन वटा वाली धनवचक: ४४.४४ वोट प्रति हेक्टर (६० से.मी. x ३० से.मी.), ६६.६६६ वोट प्रति हेक्टर (५० से.मी. x २४ से.मी.) र ८२.३२३ वोट प्रति हेक्टर (६० से.मी. x २० से.मी.) को प्रभाव वारे अध्ययन गरिएको थियो। उक्त परिश्रमको नेतृत्व अनुसार नाडुङ्जनको मात्रा २०० क्र० क्र०, प्रति हेक्टर प्रमाण गर्न सवैभाष्यक बिही ६४०.४६ क्र० क्र०, प्रति हेक्टर उल्ल्यानी पाइयो। नाडुङ्जनको मात्रा: २०, १००, १२० तथा २०० क्र० क्र०, प्रति हेक्टरको प्रमाणमा नाडुङ्जन प्रमाण गर्ने अनुमानहरू केही ६२.५२, १०४.५४, १२४.६३ र १४४.५४ प्रतिशत (%) बढी उच्चानी पियो। बाली घनाल ६२.६६६ वोट प्रति हेक्टर को प्रमाण गर्दी ५१२.७९ क्र० क्र०, प्रति हेक्टर उल्ल्यानी पाइयो। जुन ५४.४४ वोट प्रति हेक्टरको प्रमाण बढी उच्चानी पियो। २०० क्र० क्र०, प्रति हेक्टर नाडुङ्जन र ६२४.६६६ वोट प्रति हेक्टरको अनुसन्धान बाट सवैभाष्यक बिही (६५.५५ क्र० क्र०, प्रति
लेखक) उजागर दियो । नाग्ट्रोजनको माघा बढाउँ लै जानादा उपायकल्पमा प्राध्यापन पार्ने तत्त्वज्ञ गर्ने- धोगा सबी, प्रति ने, योगको गम्याई, धोपाको मोटाई, दाना तर सबी प्रति योगा, दाना सबी प्रति तर, १००० चट दानाको तील बढाउँ गएको देखियो । तर तेह धनल बढाउँ लै जानादा उकाँ तत्त्वज्ञ घटेको पाइए । नाग्ट्रोजनको माघा बढाउँ लै जानादा धोगा नवागेका (धारी) मोटासको सबी घटाउँ गएको र वासी धनल बढाउँ लै जानादा सो तल बढाउँ गएको देखियो । २०० के.वी. प्रति हेक्टर नाग्ट्रोजनको माघा प्रशिक्षण गर्ने सचेतन बढी मुनाफाबाट अनुपात (१.३७) र खुद नाफा (६.४२८०८.४२) पाइए । वासी धनल ६६.६६६ बोट प्रति हेक्टर प्रशिक्षण बाट सबेच्छन्य बढी मुनाफाबाट अनुपात (१.१४) र खुद नाफा (६.५४५१२.७५) पाइए । ६६.६६६ बोट प्रति हेक्टरको प्रशिक्षण गर्ने ८२.२२२ बोट प्रति हेक्टर र ५५.७५७ बोट प्रति हेक्टर को बन्धा कम्य १०.९६ र ७९.५४ प्रतिव्युत्पात बढी खुद नाफा दिइ । २०० के.वी. प्रति हेक्टर नाग्ट्रोजन र ६६.६६६ बोट प्रति हेक्टरको अन्तरसंप्राकार सबेच्छन्य बढी मुनाफाबाट अनुपात (२.७०) र खुद नाफा (५.५८६०६.८५) पाइए । प्राप्त नलिकाको विशेष्य संख्या २०० के.वी. प्रति हेक्टर नाग्ट्रोजन र बाली धनल ६६.६६६ बोट प्रति हेक्टर (६० से.म. x २५ से.म. ) को प्रशिक्षण बाट सबेच्छन्य बढी उजागर र आम्दानी पाइए ।

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1 INTRODUCTION

Maize (Zea mays L.) is the world’s widely grown cereal and primary staple food crop in many developing countries. It ranks the second position in terms of world’s cereal grain production. Its global production area is about 140 million hectares, of which approximately 96 million hectares are in the developing countries. World maize production is about 602 million tons, although 68% of the world maize area is in developing countries, only 46% of the world’s maize production is produced there (FAO, 2003).

It is the second most important staple food crop both in terms of area and production after rice in Nepal. It is grown in 850947 hectare of land with average yield of 2038 kg/ha. Maize occupies about 27.52% of the total cultivated agricultural land and shares about 22.65% of the total cereal production in Nepal (SINA, 2005/06). It shares about 6.87% to Agricultural Gross Domestic Product (MOAC, 2006). The proportion of maize area consists of 70% in mid hills followed by 22% in Terai and 8% in high hills (Pathik, 2002).

The per capita consumption of maize is 165 g/day but per capita consumption is 225 and 80 g/day in hills and Terai, respectively (Adhikari, 2001). As a result of growing maize consuming population in the hills as well as increasing use of maize for feed in the rapidly expanding poultry and dairy sector, the demand for maize is increasing very fast but its production is growing slowly. The production is increasing slowly at the rate of 1.4% per year (Koirala, 2001), however, the average annual growth rate of maize yield is 1.05% (Paudyal and Ransom, 2001). The growth in the use of maize grain as animal feed and for other industrial products is now at 10-15% per annum, particularly in Terai, inner Terai and urban areas. The overall demand for maize-driven by increased demand for human consumption and livestock feed is expected to grow by 4-6% per year over the next 20 years (CIMMYT, 1997/98).
Maize has got highest production potential among the crop plants and has wide variability in plant morphology. It is cultivated in a wider range of environment than wheat and rice because of its greater adaptability (Koutsika-Sotiriou, 1999). The present yield of maize in Nepal is quite lower than that of other Asian countries. There is wide gap between potential yield of open pollinated varieties having 5 t/ha (on station experimental yield), attainable yield of 3.5 t/ha (on farm yield with improved practices) and actual yield of 2.03 t/ha (national average yield) (Ojha, 2006). One of the main factors for low yield of maize is loss of soil fertility and lower use of fertilizer input. Chemical fertilizer especially nitrogen fertilizer is universally accepted as a key component to high corn yield and optimum economic return (Gehl et al., 2005). It plays important role in metabolism, growth, reproduction and heredity of plant (Jain, 1990). Plant growth is adversely affected due to deficiency of nitrogen as it restricts the formation of enzymes, chlorophyll and proteins necessary for growth and development (Reddy and Reddy, 2002). The effective management of nitrogen fertilizer in relation to time is also important aspect of crop production. The tasseling and silking stages are critical stages of maize for nitrogen application. So nitrogen application at these stages following 50% of total nitrogen as basal gives higher production in maize.

The highest yield of a particular crop can be obtained only if optimum plant population is maintained. Both thicker and thinner plant population than the recommended ones for a normal production system reduces economic yield. The appropriate plant population for each crop varies greatly from region to region depending upon climate, soil and management practices. The competition between plants may not occur and resources are not efficiently used at very low plant densities. Under low plant densities, grain yield is limited by the inadequate number of plants whereas at higher plant densities, it declines mostly because of an increment in the number of aborted kernels and/or barren stalks. At higher plant densities,