“EFFECT OF NITROGEN AND POTASH LEVELS ON GROWTH AND GREEN POD YIELD OF OKRA (Abelmoschus esculentus L. Moench) DURING KHARIF SEASON UNDER MIDDLE GUJARAT CONDITIONS”

BY

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ANAND, GUJARAT (INDIA)
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2016

Reg. No. 04-2335-2014
Dedicated To
My Beloved
Parents
and
Respected Guide
Abstract
“Effect of nitrogen and potash levels on growth and green pod yield of okra (*Abelmoschus esculentus* L. Moench) during *kharif* season under middle Gujarat conditions”

Name of Student: Chaudhari Jayminkumar G.  
Major Advisor: Dr. S. N. Shah

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**ABSTRACT**

The field experiment was conducted at Main Vegetable Research Station, Anand Agricultural University, Anand to study the “Effect of nitrogen and potash levels on growth and green pod yield of okra (*Abelmoschus esculentus* L. Moench) during *kharif* season under middle Gujarat conditions” during the year 2015. The soil of experimental field was loamy sand in texture having good drainage and 7.7 pH at 0-15 cm soil depth. The experiment was laid out in RBD with factorial concept in three replications. The treatment comprised of four nitrogen levels (75, 100, 125 and 150 kg N ha\(^{-1}\)) and five levels of potash (25, 50, 75, 25 as basal + 25 at 45 DAS and 37.5 as basal + 37.5 at 45 DAS kg K\(_2\)O ha\(^{-1}\)).

Results revealed that nitrogen levels showed non-significant influence on the plant population of okra recorded at initial and at harvest. Growth attributes *viz.*, plant height recorded at 30 DAS found non significant and it was significant at harvest and recorded higher with application of 150 kg N ha\(^{-1}\) but it was at par with 125 kg N ha\(^{-1}\). Number of branches plant\(^{-1}\) and days to initiation flowering
were significantly higher with application of 150 kg N ha\textsuperscript{-1} as compared to rest of the treatments.

Yield attributes \textit{viz.}, number of pods plant\textsuperscript{-1}, length of pod, girth of pod and weight of pods plant\textsuperscript{-1} of okra were significantly affected by nitrogen levels. The number of pods plant\textsuperscript{-1}, length of pod, girth of pod and weight of pods plant\textsuperscript{-1} were significantly higher under the application of 150 kg N ha\textsuperscript{-1} as compared to rest of the treatments, however, number of pods plant\textsuperscript{-1}, length of pod, girth of pod weight of pods plant\textsuperscript{-1} were at par with application of 125 kg N ha\textsuperscript{-1}.

Application of 150 kg N ha\textsuperscript{-1} to okra recorded significantly higher green pod yield (147.31 q ha\textsuperscript{-1}). However, it was at par with 125 kg N ha\textsuperscript{-1}.

Different nitrogen levels failed to show their significant effect on moisture percentage and mucilage content but total chlorophyll content was significantly improved by nitrogen levels. Application of 150 kg N ha\textsuperscript{-1} to okra recorded significantly higher total chlorophyll content. However, it was at par with 125 kg N ha\textsuperscript{-1}.

Different nitrogen levels failed to show their significant effect on organic carbon, available phosphorus and potassium in soil after harvest of crop but available nitrogen in soil after harvest of crop was significantly improved by nitrogen levels. Whereas, other chemical parameters \textit{viz.}, content of N in plant were increased with the increase in levels of nitrogen from 75 to 150 kg N ha\textsuperscript{-1}. Different
nitrogen levels failed to show their significant effect on P and K content in plant.

Plant population recorded at initial and at harvest were failed to reflect their significant effect due to different potash levels. Similarly plant height and days to initiation was found non-significant effect due to different potash levels.

Growth and Yield parameters *viz.*, Number of branches plant$^{-1}$, number of pods plant$^{-1}$, length of pod, girth of pod and weight of pods plant$^{-1}$ of okra were significantly affected by different potash levels and these were significantly higher under application of 37.5 kg K$_2$O ha$^{-1}$ as basal + 37.5 kg K$_2$O ha$^{-1}$ at 45 DAS compared to other levels.

Green pod yield of okra was significantly affected due to different potash levels. The application of 37.5 kg K$_2$O ha$^{-1}$ as basal + 37.5 kg K$_2$O ha$^{-1}$ at 45 DAS produced significantly higher green pod yield (132 q ha$^{-1}$). However, it was at par with application of 25 kg K$_2$O ha$^{-1}$ as basal + 25 kg K$_2$O ha$^{-1}$ at 45 DAS and 75 kg K$_2$O ha$^{-1}$ as basal.

Different levels of potash failed to reflect their significant effect on moisture percentage but mucilage content and total chlorophyll content was significantly improved by potash levels. Mucilage content and total chlorophyll content was significantly higher under application of 37.5 kg K$_2$O ha$^{-1}$ as basal + 37.5 kg K$_2$O ha$^{-1}$ at 45 DAS. However, it was at par 25 kg K$_2$O ha$^{-1}$ as basal + 25 kg K$_2$O ha$^{-1}$ at 45 DAS and 75 kg K$_2$O ha$^{-1}$ as basal.
Abstract

Different levels of potash failed to reflect their significant effect on organic carbon, available nitrogen and available phosphorus but available potash in soil after harvest of crop was significantly improved by potash levels. Moreover, content of N and P in plant were non-significant but K content was significantly influenced due to potash levels. K content in plant significantly higher under application of 37.5 kg K₂O ha⁻¹ as basal + 37.5 kg K₂O ha⁻¹ at 45 DAS. However, it was at par 25 kg K₂O ha⁻¹ as basal + 25 kg K₂O ha⁻¹ at 45 DAS and 75 kg K₂O ha⁻¹ as basal.

The interaction effects of different levels of nitrogen and potash levels were found significant with respect to number of pods plant⁻¹, weight of pod plant⁻¹ and green pod yield. Significantly the higher values of number of pods plant⁻¹ and weight of pod plant⁻¹ were recorded under treatment combination of application of 150 kg N ha⁻¹ along with 37.5 kg K₂O ha⁻¹ as basal + 37.5 kg K₂O ha⁻¹ at 45 DAS and it was at par with treatment combination of 125 kg N ha⁻¹ along with 25 kg K₂O ha⁻¹ as basal + 25 kg K₂O ha⁻¹ at 45 DAS, 125 kg N ha⁻¹ along with 37.5 kg K₂O ha⁻¹ as basal + 37.5 kg K₂O ha⁻¹ at 45 DAS, 125 kg N ha⁻¹ along with 75 kg K₂O ha⁻¹ as basal, 150 kg N ha⁻¹ along with 25 kg K₂O ha⁻¹ as basal + 25 kg K₂O ha⁻¹ at 45 DAS, 150 kg N ha⁻¹ along with 75 kg K₂O ha⁻¹ as basal. Whereas significantly higher green pod yield was recorded under treatment combination of 150 kg N ha⁻¹ along with 37.5 kg K₂O ha⁻¹ as basal + 37.5 kg K₂O ha⁻¹ at 45 DAS and it was at par with treatment combination of 125 kg N ha⁻¹ along with 25 kg K₂O ha⁻¹ as basal + 25 kg K₂O ha⁻¹ at 45 DAS, 125 kg N ha⁻¹ along with 75 kg K₂O ha⁻¹ as basal.
Abstract

ha\(^{-1}\) along with 25 kg K\(_2\)O ha\(^{-1}\) as basal + 25 kg K\(_2\)O ha\(^{-1}\) at 45 DAS, 125 kg N ha\(^{-1}\) along with 37.5 kg K\(_2\)O ha\(^{-1}\) as basal + 37.5 kg K\(_2\)O ha\(^{-1}\) at 45 DAS, 125 kg N ha\(^{-1}\) along with 75 kg K\(_2\)O ha\(^{-1}\) as basal. 150 kg N ha\(^{-1}\) along with 25 kg K\(_2\)O ha\(^{-1}\) as basal + 25 kg K\(_2\)O ha\(^{-1}\) at 45 DAS, 150 kg N ha\(^{-1}\) along with 75 kg K\(_2\)O ha\(^{-1}\) as basal.

Application of 150 kg N ha\(^{-1}\) accrued maximum net realization of ₹232731 ha\(^{-1}\) with benefit cost ratio of 3.76 followed by application of 125 kg N ha\(^{-1}\). Application of 37.5 kg K\(_2\)O ha\(^{-1}\) as basal + 37.5 kg K\(_2\)O ha\(^{-1}\) at 45 DAS registered the highest net realization ₹203149 ha\(^{-1}\) with maximum benefit cost ratio of 3.27 followed by application of 25 kg K\(_2\)O ha\(^{-1}\) as basal + 25 kg K\(_2\)O ha\(^{-1}\) at 45 DAS. Maximum benefit cost ratio 4.23 was recorded under the treatment combination of 125 kg N ha\(^{-1}\) along with 25 kg K\(_2\)O ha\(^{-1}\) as basal + 25 kg K\(_2\)O ha\(^{-1}\) at 45 DAS followed by treatment combination of 150 kg N ha\(^{-1}\) along with 37.5 kg K\(_2\)O ha\(^{-1}\) as basal + 37.5 kg K\(_2\)O ha\(^{-1}\) at 45 DAS. From the above findings, it can be indicated that application of 125 kg N ha\(^{-1}\) along with 25 kg K\(_2\)O ha\(^{-1}\) as basal + 25 kg K\(_2\)O ha\(^{-1}\) at 45 DAS to kharif okra (cv. Gujarat Anand Okra-5), produced higher green pod yield and gave maximum net profit.
Dr. S. N. Shah
Associate Professor
Department of Agronomy
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Anand Agricultural University
Anand-388110

CERTIFICATE

This is to certify that the thesis entitled “EFFECT OF NITROGEN AND POTASH LEVELS ON GROWTH AND GREEN POD YIELD OF OKRA (Abelmoschus esculentus L. Moench) DURING KHARIF SEASON UNDER MIDDLE GUJARAT CONDITIONS” submitted by Chaudhari Jayminkumar G. (Reg. No. 04-2335-2014) in partial fulfillment of the requirements for the award of the degree of MASTER OF SCIENCE (AGRICULTURE) in AGRONOMY of the Anand Agricultural University is a record of bonafide research work carried out by him under my personal guidance and supervision. The thesis has not previously formed the basis for award of any degree, diploma or other similar title.

Place: Anand
Date: /07/2016

(S. N. Shah) Major Advisor
DECLARATION

This is to certify that whole of the research work reported in the thesis in partial fulfillment of the requirement for the award of the degree of Master of Science (Agri.) in the subject of Agronomy is the result of investigation done by undersigned under the direct guidance and supervision of Dr. S. N. Shah, Associate Professor (Agronomy), B. A. College of Agriculture, Anand Agricultural University, Anand-388110 and no part of the research work has been submitted for any other degree so far.

Place: Anand
Date: /07/2016 (Jayminkumar G. Chaudhari)

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DATE: 07/07/2016

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<td>GAO-5</td>
<td>Gujarat Anand Okra -5</td>
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<td>GAU</td>
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<td>HAU</td>
<td>Haryana Agricultural University</td>
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<td>HPKV</td>
<td>Himachal Pradesh Krishi Vishva Vidhyalaya</td>
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<td>IIHR</td>
<td>Indian Institute of Horticultural Research</td>
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<td>JNKVV</td>
<td>Jawahar lal Nehru Krishi Vishva Vidhyalaya</td>
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<tr>
<td>K</td>
<td>Potassium</td>
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<td>K₂O</td>
<td>Potassium oxide</td>
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<tr>
<td>Kg</td>
<td>Kilogram</td>
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<tr>
<td>kg ha⁻¹</td>
<td>Kilogram per hectare</td>
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<td>kg N ha⁻¹</td>
<td>Kilogram nitrogen per hectare</td>
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<td>Km</td>
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<td>km hr⁻¹</td>
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<td>mm day⁻¹</td>
<td>Millimeter per day</td>
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<tr>
<td>MOP</td>
<td>Murate of potash</td>
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<td>Per net plot</td>
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<td>NS</td>
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<tr>
<td>P</td>
<td>Phosphorus</td>
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<td>P = 0.05</td>
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<tr>
<td>P₂O₅</td>
<td>Phosphorus pentoxide</td>
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<td>PB</td>
<td>Pair of Bullock</td>
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<td>pH</td>
<td>Potential of hydrogen ion</td>
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<td>plant⁻¹</td>
<td>Per plant</td>
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<td>Pods plant⁻¹</td>
<td>Pods per plant</td>
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<td>Q ha⁻¹</td>
<td>Quintal per hectare</td>
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<td>RAU</td>
<td>Rajasthan Agricultural University</td>
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<td>S. Em.</td>
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<td>Sig.</td>
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<td>Sr. No.</td>
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<tr>
<td>SSP</td>
<td>Single Super Phosphate</td>
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<td>Year⁻¹</td>
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Introduction
I. INTRODUCTION

Okra (*Abelmoschus esculentus* L. Moench) is an important vegetable crop belonging to the family Malvaceae and grown throughout the tropical and subtropical regions of the world. It requires a long warm growing season and is susceptible to frost. Okra is known by local names in different parts of the world, such as Lady's finger in England, Gumbu in United State of America, Gombu in France, Dherosh in Bangladesh and Bhindi in India. It is cultivated throughout India during *kharif* and *summer* seasons. In world, India ranks second in production of vegetables, next to China with 1628.93 million tonnes from 93.96 million hectares of land (Anon., 2015). In the World, Okra is grown in area of 1.11 million hectares with an annual production of 87.10 million tonnes with productivity of 7.8 tonnes ha⁻¹. In India, it is cultivated in 0.51 million hectares area with an annual production of 6.35 million tonnes with productivity of 12.01 tonnes ha⁻¹. In India, it is widely cultivated in Bihar, Orissa, West Bengal, Andhra Pradesh, Madhya Pradesh, Karnataka, Gujarat and Assam. Okra is one of the important vegetable crop of Gujarat, covering an area of 65.66 thousand hectares area with an annual production of 723.33 tonnes and productivity of 11.00 tonnes ha⁻¹ (Anon., 2015). Surat, Vadodara, Junagadh, Banaskantha, Bhavnagar, Valsad, Gandhinagar and Anand are major okra growing districts in the Gujarat state.

Okra is a multipurpose crop. Its tender pods are cooked as vegetables, stewed with meat, cooked to make soup and also canned and dried. Mature pods and stems containing crude fibre are used in the paper industry. Mucilage extracts from
the okra plant is used as a classifier in purifying the cane juice for manufacturing of jaggery as well as sugar. Okra has nutritional as well as medicinal value. Its every 100 g green pod contains 1.9 g protein, 6.4 g carbohydrate, 1.2 g fiber, 13 mg vitamins C and 66 mg Ca (Bose and Som 1986). The green tender fruit contains oxalic acid, thiamine, riboflavin, nicotinic acid and also vitamins A, B and C. The okra fruit is excellent source of iodine which is necessary for the resistance against throat disease e.g. goiter. It is good for the people suffering from heart weakness. Okra is said to be very useful against genitor-urinary disorder while mucilage has emollient and diuretic value.

Production of the vegetable okra often suffers a setback due to unavailability of proper inputs. Amongst the several factors responsible for better crop production, nutrient supply is most important. For obtaining maximum green fruit yield with better quality, the proper growth of the plant and its fruits are desired. This can be achieved to great extend by the use of optimum dose of nitrogenous and potashic fertilizers.

Nutrient supply in the soil is principal factor that determines the crop growth and yield. Among the nutrient, nitrogen is the main limiting factor in most of the soils and the need for its application in one form or in another form has been well recognized in vegetable and other farm crops for increasing the yield as it exhibits a high positive response in okra. Nitrogen is an essential element and important determinant in growth and development of crop plants. It plays an important role in chlorophyll, protein, nucleic acid, hormone and vitamin synthesis and also helps in
cell division, cell elongation. Among the three major plant nutrients, yield response of okra to nitrogen is assured to be of great important. It imparts the healthy green colour to leaves, stem and enables efficient photosynthesis. Application of judicious nitrogen is the reliable way of increasing the green fruit yield of okra.

Potassium is one of the principle plant nutrients under pinning crop yield production and quality determination. It is important major element for plant growth. It is needed to large amount than phosphorus within the live plant tissue. Potassium called as the quality element among the three (N, P and K) required in major amount. It helps in plant using more effectively and help in translocation of heavy metal such as iron and in ionic balance and also in the development of a strong and healthy root system increase the efficiency of the uptake and use of nitrogen and other nutrients. Potassium activates many enzymes and plays an important role in the maintenance of electrical potential gradients across cell membranes and the generation of turgor in plants. It regulated photosynthesis, protein synthesis and starch synthesis. It is also the major cation for the maintenance of cation-anion balances. Potassium aids plant in resisting disease, insect, cold weather and drought. Beneficial effect of split dose of potassium application have been reported in many crop plant. However, it is lacking in okra (Singh et al., 1998). Crops with an adequate supply of potash throughout growing season have a better appearance, taste and also produce food free of the signs of pest and disease. In fruits and vegetables, K increase size, vitamin C and sugar content and improves flavour and colour.
In view of this, experiment entitled “Effect of nitrogen and potash levels on growth and green fruit yield of okra (Abelmoschus esculentus L. Moench) during kharif season under middle Gujarat conditions” conducted in kharif season of the year 2015 at Main Vegetable Research Station, Anand Agricultural University, Anand with the following objectives.

**OBJECTIVES:**

1. To find out the requirement of nitrogen and its effect on growth and green fruit yield of okra
2. To find out the requirement of potash and its effect on growth and green fruit yield of okra
3. To study the interactive effect of nitrogen and potash on growth and green fruit yield of okra
Review of Literature
II. REVIEW OF LITERATURE

Okra (*Abelmoschus esculentus* L. Moench) is an annual vegetable crop grown by botanical seed in tropical and sub tropical parts of the world. It is a nutritious vegetable and plays an important role to meet the demand of vegetables during rainy reason of the country, when vegetables are scanty in the market. To sustain high productivity of okra, judicious use of nutrients is indispensable.

There is enough literature available on effect of nitrogen and potash levels on growth and green pod yield of okra. The relevant literature has been reviewed on okra under following heads.

2.1 EFFECT OF NITROGEN LEVELS

2.2 EFFECT OF POTASH LEVELS

2.3 INTERACTIVE EFFECT OF NITROGEN AND POTASH LEVELS

2.1 EFFECT OF NITROGEN LEVELS

2.1.1 EFFECT OF NITROGEN LEVELS ON GROWTH ATTRIBUTES

A field experiment was conducted on okra *cv.* Parbhani Kranti in sandy soils at Maharajpur Vegetable Research Farm, J.N. Krishi Vishwa Vidhyalaya, Jabalpur (M.P.) during *kharif* seasons of 1992 and 1993 to study the effect of sowing dates and nitrogen fertilization (50, 100 and 150 kg N ha⁻¹) on seed crop of okra. From the results Dwivedi *et al.* (1994) found that maximum plant height, branches plant⁻¹ and
initiation of flowering were observed when nitrogen was applied at higher rate (150 kg N ha\(^{-1}\)).

Ahmed and Tanki (1997) carried out an experiment at the Vegetable Experimental Farm, S. K. University of Agricultural Science and Technology, Srinagar during summer 1992 and 1993 with four levels of nitrogen (0, 40, 80, and 120 kg ha\(^{-1}\)). They observed that plant height and number of branches plant\(^{-1}\) increased linearly with every additional dose of nitrogen up to 120 kg N ha\(^{-1}\).

Ram et al. (1999) conducted field experiment at Horticultural Farm, S. K. N. College of Agriculture, RAU, Jobner (Rajasthan) to study the effect of nitrogen levels (30, 60, 90 and 120 kg ha\(^{-1}\)) on growth and fruit yield of okra cv. Parbhani Kranti during the year 1996. The results revealed that application of 120 kg N ha\(^{-1}\) recorded higher values of plant height, number of branches plant\(^{-1}\) and fruit yield as compared to other levels of N barring 90 kg N ha\(^{-1}\).

A field trial on the effect of nitrogen (40, 80 and 120 kg N ha\(^{-1}\)) on growth and yield of okra cv. Pusa sawani was carried out during kharif season of 1995 at RAU, S. K. N. College of Agriculture, Jobner (Rajasthan). From the results, Paliwal et al. (1999) concluded that with the increase of nitrogen levels upto 120 kg N ha\(^{-1}\), plant height and number of branches plant\(^{-1}\) were increase linearly.

Ambare et al. (2005) conducted the field experiment at Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, during kharif, 2002 in
clay loam soil to study the effect of nitrogen on growth of okra varieties. The treatments comprising of five levels of nitrogen *viz.* 0, 25, 50, 75 and 100 kg N ha⁻¹. They observed that increasing levels of nitrogen (upto 100 kg N ha⁻¹), significantly increased the plant height, number of branches plant⁻¹ and days to initiation of flowering.

Firoz (2009) conducted an experiment with four levels of nitrogen (60, 80, 100 and 120 kg ha⁻¹) at the Hill Agricultural Research Station, Khagrachari, Bangladesh to find out the effect of nitrogen on growth of okra in hill slope condition during rainy season. He reported that, the highest values of plant height and number of branches plant⁻¹ were registered maximum with application of 120 kg N ha⁻¹.

A field experiment was conducted on okra at krishi vigyan Kendra, Sonipat of CCSHAU, Hissar during *kharif* seasons of 2004 and 2005 to study the effect of spacing and nitrogen fertilization (60, 100, 140 and 180 kg N ha⁻¹) on seed yield of okra. From the results Nandal *et al.* (2010) found that maximum plant height and branches plant⁻¹ were observed when nitrogen was applied at higher rate (150 kg N ha⁻¹).

**2.1.2 EFFECT OF NITROGEN LEVELS ON YIELD ATTRIBUTES AND YIELD**

Pandey *et al.* (1980) carried out field experiment on okra variety Pusa Sawani during rainy seasons of 1976 and 1977 at HAU, Hisar to study the effect of levels of nitrogen (0, 40, 80 and 120 kg ha⁻¹) and phosphorus (0, 25 and 50 kg ha⁻¹) on seed production. From the
results, they reported that number of pods plant$^{-1}$ and number of seeds
pods$^{-1}$ were increased with the increase in application of nitrogen upto
120 kg ha$^{-1}$. Significantly the highest seed yield was also recorded
under the highest level of nitrogen (120 kg ha$^{-1}$).

A field experiment was carried out at Vegetable Research cum Seed
Production Centre, Kaul (Hisar) on sandy loam soil for two years (1976-
77 to 1977-78) to study the effect of nitrogen levels (0, 40, 80 and 120
kg ha$^{-1}$) on seed production of okra cv. Parbhani Kranti. From the
results, Singh and Pandita (1981) concluded that application of 120 kg
N ha$^{-1}$ produced significantly higher number of pods plant$^{-1}$ and pod
yield as compared to rest of the levels.

A field experiment was conducted in highly calcareous soil at
Vegetable Research Farm of the Rajendra Agricultural University, Pusa
(Bihar) during the years 1983-1985 to study the effect of nitrogen levels
(0, 40, 80 and 120 kg ha$^{-1}$) on seed production of okra. From the
results, it was observed that number of pods plant$^{-1}$ and yield were
significantly influenced due to nitrogen levels and significantly the
highest values of these traits were recorded under the application of 80
kg N ha$^{-1}$ (Mishra and Pandey, 1987)

Naik and Srinivas (1992) carried out a field experiment during the
rainy seasons (1985-1986) to study the influence of nitrogen fertilization
on seed yield of okra cv. Pusa sawani with four levels of  N (50, 100,
150, and 200 kg ha$^{-1}$) at IIHR, Banglore, karnataka. The results
revealed that pods length, number of pods plant\(^{-1}\) and yield increased significantly with increase in levels of nitrogen up to 200 kg ha\(^{-1}\).

Fagaria \textit{et al.} (1993) conducted a field experiment under mid-hill conditions at Vegetable Farm, HPKV, Palampur during \textit{kharif} 1990 and 1991 to study the effect of nitrogen levels (50, 75 and 100 kg N ha\(^{-1}\)) on yield and its attributes in okra. Results showed that maximum values of number of pods plant\(^{-1}\), pod length, pod girth and yield were obtained with the application of 100 kg N ha\(^{-1}\). However, it was at par with 75 kg N ha\(^{-1}\).

Birbal \textit{et al.} (1995) conducted a field experiment at Vegetable Research Farm of Haryana Agricultural University, Hisar in sandy loam soil having 8.5 pH to find out the response of okra \textit{cv.} Varsha Uphar to four levels of nitrogen (0, 50, 100 and 150 kg ha\(^{-1}\)) in \textit{kharif} season of 1992. From the results, they observed that number of pods plant\(^{-1}\) and pod yield were significantly increased upto application of 100 kg N ha\(^{-1}\).

Singh (1995) conducted an field experiment at Western campus, Modipuram, Meerut of G.B. Pant University of Agriculture and Technology, Pantnagar during the \textit{kharif} seasons of 1992 and 1993 to study the effect of various levels of nitrogen (0, 30, 60, 90, 120 and 150 kg N ha\(^{-1}\)) on yield and quality of okra. From the results, he found that pods plant\(^{-1}\), length of pod and yield were increased with the increasing level of nitrogen but significant variation were observed upto 90 kg N ha\(^{-1}\) in most of the characters.
A field experiment was conducted during 1988 to study the effect of N- levels on yield of okra at Marathwada Agricultural University, Purbhani by Sontakke et al. (1996). Treatments consisted of four nitrogen levels (0, 40, 80, 120 and 160 kg N ha\(^{-1}\)). They observed that significantly the highest number of pods plant\(^{-1}\) and yield of pods were obtained from plots which received 80 kg N ha\(^{-1}\) compared to other treatments.

Bhat and Dhar (1999) conducted the field trial on okra cv. Parbhani Kranti with four nitrogen levels (40, 50, 60 and 70 kg ha\(^{-1}\)) at Rajouri, Jammu and Kashmir during the kharif season of 1994. From the results, they observed that number of pods plant\(^{-1}\) and yield increased with increasing level of nitrogen and the highest values of these attributes were recorded under the highest level of nitrogen (70 kg ha\(^{-1}\)). Similarly, higher pod length, pod girth and number of pods plant\(^{-1}\) were recorded under application of 120 kg N ha\(^{-1}\). (Ram et al. 1999).

A field experiment was conducted at Nagina, Uttar Pradesh, during the kharif seasons of 1998 and 1999 to study the effect of nitrogen (80, 100 and 120 kg ha\(^{-1}\)) on seed yield of okra cv. Parbhani Kranti. From the results, Prasad and Singh (2001) found that yield was significantly increased with the increase in nitrogen rate. The highest number of pod plant\(^{-1}\) and yield were also noticed under the highest level of nitrogen (120 kg ha\(^{-1}\)).
Shanke et al. (2003) conducted field experiment at Akola (Maharashtra) during summer season of 1998 to assess the seed yield potential and other growth characters of okra cv. Parbhani Kranti under 5 levels of nitrogen (0, 50, 75, 100 and 125 kg ha\(^{-1}\)). The results revealed that there was linear response in almost all the yield attributing parameters with increasing level of nitrogen. The maximum number of pods plant\(^{-1}\), pod length and seed yield were observed under the highest level of nitrogen (125 kg ha\(^{-1}\)) as compared to rest of the nitrogen levels.

A field experiment was carried out by Singh et al. (2006) at the Horticulture Research Farm, Ch. Charan Singh University Campus, Meerut to study the effect of nitrogen and micro-nutrient on growth and yield of okra. The result revealed that maximum plant height, number of leaves plant\(^{-1}\), number of primary branches plant\(^{-1}\), number of green pod plant\(^{-1}\) and yield of green fruit recorded with the 100 kg N ha\(^{-1}\) as compared to control.

A field experiment was conducted by Singh et al. (2008) during spring season at C.S. Azad University of Agriculture and Technology, Kanpur to study the effect of nitrogen and plant geometry on growth and yield of okra. The study comprised of four levels of N (\(N_0\)-control, \(N_1\)-60 kg, \(N_2\)-90 kg and \(N_3\)-120 kg ha\(^{-1}\)) with three planting density (40×20, 40×30, and 40×40 cm.). They reported that application of nitrogen 120 kg ha\(^{-1}\) gives maximum nodes plant\(^{-1}\), number of green
leaves plant\(^{-1}\), fresh weight of pod plant\(^{-1}\) and yield of green pods of okra.

Suthar \textit{et al.} (2009) conducted a field experiment at the Regional Research Station, Anand Agricultural University, Anand during \textit{kharif} 2006 to study the effect of organic manures and nitrogen levels (75, 100 and 125 kg ha\(^{-1}\)) on seed yield and seed quality of okra var. Gujarat Anand Okra-2. They observed that higher value of pod length, pod girth, pod weight, number of seeds pod\(^{-1}\), test weight and seed yield were recorded with the highest level of nitrogen (125 kg ha\(^{-1}\)).

Singh \textit{et al.} (2010) conducted a field experiment at Horticulture farm, Ghazipur, (Uttar Pradesh) to study the effect of nitrogen, phosphorus and bio-fertilizer on growth, yield and quality of okra. The treatment comprised of two levels of nitrogen (40 and 60 kg ha\(^{-1}\)), two levels of phosphorus (40 and 60 kg ha\(^{-1}\)) and two levels of \textit{Azotobacter} (B\(_0\) = no \textit{Azotobacter} and B\(_1\) = treatment with \textit{Azotobacter}). The result revealed that application of nitrogen @ 60 kg ha\(^{-1}\) with phosphorus @ 60 kg ha\(^{-1}\) along with bio-fertilizer gave significantly higher fruit yield of okra.

A field trial on the effect of nitrogen (75, 100 and 125 kg N ha\(^{-1}\)) and mulching on yield of okra \textit{cv.} Pusa sawani was carried out during summer season of 2005-06 at Costal Soil Salinity Research Station, Danti-Umbharat, Navsari Agricultural University, Navsari. From the results, Naik \textit{et al.} (2011) concluded that with the increase of nitrogen
levels upto 125 kg N ha\(^{-1}\), fruit yield were increase linearly.

A field experiment was conducted during kharif season of 2005 and 2006 to assess the effects of sources of nutrients and their levels on the performance of okra. The treatment comprised of four doses of vermicompost (0, 3, 4 and 5 t ha\(^{-1}\)) and four levels of chemical fertilizer 0, 40:30:30, 60:45:45 and 80:60:60 kg NPK ha\(^{-1}\). They found that application of 80:60:60 kg NPK ha\(^{-1}\) with vermicompost 5 t ha\(^{-1}\) gave significantly higher fruit yield (69.2 q ha\(^{-1}\)) and protein content (18.0%) as well as B:C ratio (Sharma et al., 2011).

The experiment was conducted by Singh et al. (2012) during spring season at Agricultural research field of Horticulture Department of P. G. College, Ghazipur to study the response of combined effect of different levels of nitrogen, spacing and green fruit picking on growth, pod yield, seed yield and seed quality of okra. Four levels of nitrogen (40, 80, 120 and 160 kg ha\(^{-1}\)) and two spacing (30×15 and 45×15 cm) were used. The result revealed that the maximum number of pod plant\(^{-1}\) and fruit yield of okra were recorded with higher dose of nitrogen (160 kg ha\(^{-1}\)).

Deepika et al. (2015) conducted field experiment on okra during rainy seasons of 2013 and 2014 at Main Horticultural Station, Bagalkot (Karnataka) to study the effect of levels of nitrogen (75, 100, 125 and 150 kg ha\(^{-1}\)) and phosphorus (50, 75 and 100 kg ha\(^{-1}\)) on the growth, yield and nutritional quality of okra. From the results, they reported that number of pods plant\(^{-1}\), fruit length, fruit girth and fruit yield were
increased with the increase in application of nitrogen up to 150 kg ha\(^{-1}\). Significantly the highest seed yield was also recorded under the highest level of nitrogen (150 kg N ha\(^{-1}\)).

### 2.1.3 Effect of Nitrogen Levels on Quality Parameters

A field trial on the effect of nitrogen (40, 80 and 120 kg N ha\(^{-1}\)) on growth and yield of okra cv. Pusa sawani was carried out during kharif season of 1995 at RAU, S. K. N. College of Agriculture, Jobner (Rajasthan). From the results, Paliwal et al. (1999) concluded that the chlorophyll content was increased with increased in nitrogen levels up to 120 kg N ha\(^{-1}\).

Deepika et al. (2015) conducted field experiment on okra during rainy seasons of 2013 and 2014 at Main Horticultural Station, Bagalkot (Karnataka) to study the effect of levels of nitrogen (75, 100, 125 and 150 kg ha\(^{-1}\)) and phosphorus (50, 75 and 100 kg ha\(^{-1}\)) on the growth, yield and nutritional quality of okra. From the results, they reported that chlorophyll content increased with the increase in application of nitrogen up to 150 kg ha\(^{-1}\). Significantly the highest chlorophyll content was recorded under the highest level of nitrogen (150 kg N ha\(^{-1}\)).

### 2.2 Effect of Potash Levels

#### 2.2.1 Effect of Potash Levels on Growth Attributes

Singh et al. (1998) conducted a field experiment at Banaras Hindu University, Varanasi to study the effect of different levels and methods of potassium application on growth and pod yield of okra (*Abelmoschus*...
*Esculentus* L. Moench). The treatment comprised of four levels of potassium (25, 50, 75 and 100 kg ha\(^{-1}\)). They found that application of potash @ 100 kg ha\(^{-1}\) in two split (half dose of potash at basal and half dose of potash at top dressing) gave significantly higher plant height, number of leaves plant\(^{-1}\) and days to initiation of flowering.

Nandal *et al.*, (1998) carried out field experiment during 1990-91 at vegetable research farm of CCSHAU, Hissart to study the effect of levels of phosphorus and potassium (0, 40, 80 and 120 kg ha\(^{-1}\)) on growth, yield and quality of tomato. From the results, they reported that number of fruits plant\(^{-1}\), wt. of fruits and total yield were increased with the increased in application of potash upto 80 kg ha\(^{-1}\). Significantly the highest yield was recorded under the potassium level of 80 kg K\(_2\)O ha\(^{-1}\).

Mushtaq *et al.* (2014) conducted the field experiment at experimental field of division of vegetable science, SKUAST, Srinagar during 2010-11 to study the effect of sources and levels of potassium on growth and yield of chili. The treatments comprising of four levels of potash *viz.*, 30, 60, 90 and 120 kg K\(_2\)O ha\(^{-1}\). They observed that application of potash (120 kg ha\(^{-1}\)) gave significantly higher plant height, number of branches plant\(^{-1}\) and days to first flower appearance in chilli.

### 2.2.2 Effect of Potash Levels on Yield Attributes and Yield

A field experiment was carried out at typic ustropeot and typic
haplustal soil at TNAU, coimbtore during 1980-1982 to study the effect of potash level (0, 30, 60, 90 and 120 kg ha\(^{-1}\)) on yield of bhendi cv. Pusa sawani. From the result Subbaiah et al., (1984) concluded that application of 120 kg K\(_2\)O ha\(^{-1}\) produced significantly higher pod yield as compared to rest of levels.

Jeyaraman and Balasubramanian (1988) conducted field experiment at Agricultural College and Research Institute farm, TNAU during kharif season of 1984-1985 to study the effect of levels of potash (0, 35, 70 and 105 kg K\(_2\)O ha\(^{-1}\)) on yield of okra. The results revealed that increasing levels of potash upto 105 kg ha\(^{-1}\) significantly increased yield.

A field experiment was conducted at Horticultural Experiment Station Hesaraghatta, Banglore during 1989-1990 to study the effect of potash levels (0, 25, 50, 100, 150 and 200 kg K\(_2\)O ha\(^{-1}\)) on the yield of okra. From the results Hariprakasa and Subramanian (1991) concluded that fruit yield were significantly influenced due to potash levels and significantly the highest value of yield recorded under the application of 200 kg K\(_2\)O ha\(^{-1}\).

Hassan et al., (1995) carried out the field experiment at the Department of Agronomy and Horticulture, University Pertanian, Malasiya to study the influence of levels of potassium fertilizer (0, 66 and 132 kg ha\(^{-1}\)) and mulching on growth and yield of chilli. The result revealed that application of 132 kg K\(_2\)O ha\(^{-1}\) recorded higher dry fruit yield as compared to other levels of potash.
Nandal et al., (1998) carried out field experiment during 1990-91 at Vegetable Research Farm of CCSHAU, Hissart to study the effect of levels of phosphorus and potassium (0, 40, 80 and 120 kg ha\(^{-1}\)) on growth and yield of tomato. From the results, they reported that number of fruits plant\(^{-1}\), wt. of fruits and total yield were increased with the increased in application of potash up to 80 kg ha\(^{-1}\). Significantly the highest yield was recorded under the level of 80 kg K\(_2\)O ha\(^{-1}\).

Nagaich et al., (1998) carried out field experiment at Horticulture Nursery of Agriculture College, Gwalior (M.P.) to study the effect of sulphur and potassium fertilization on growth and yield of onion. They found that yield was significantly increased with the increase in potash rate. The highest yield were also noticed under the highest level of potash (120 kg ha\(^{-1}\)).

A field experiment was carried out by Singh Janardan (1998) at potash research institute of India, Gurgaon, Haryana to study the effect of stockosorb polymers and potassium levels (0, 60 and 120 kg ha\(^{-1}\)) on growth and yield of onion. The results revealed that highest bulb yield was recorded with the 120 kg K\(_2\)O ha\(^{-1}\).

Singh et al. (1998) conducted a field experiment at Banaras Hindu University, Varanasi to study the effect of different levels and methods of potassium application on growth and pod yield of okra (Abelmoschus Esculentus L. Moench). The treatment comprised of four levels of potassium (25, 50, 75 and 100 kg ha\(^{-1}\)). They found that application of
potash @ 100 kg ha\(^{-1}\) in two split (half dose of potash at basal and half dose of potash at top dressing) gave significantly higher number of pod plant\(^{-1}\), pod length, pod girth and green fruit yield.

A field experiment was carried out at SKN College of Agriculture, Jobner Rajasthan to study the effect of levels of compaction and potassium (0, 30, 60 and 90) on growth and yield of chilli. From the results Majumdar and Singh (2001) concluded that application of 90 kg K\(_2\)O ha\(^{-1}\) recorded significantly higher number of fruits plant\(^{-1}\) and yield as compared to rest of levels.

A field trial on the effect of levels and sources of potassium on yield of chilli was carried out during kharif season of 2006-07 at Main Agricultural Research Station, University of Agricultural Sciences, Dharawad. From the results, Prabhavathi et al. (2008) concluded that with the increase of potash levels upto 150% RDK (RDK - 50 kg K\(_2\)O ha\(^{-1}\)), plant height, number of branches plant\(^{-1}\) and fruit yield were increase linearly.

Mushtaq et al. (2014) conducted the field experiment at Experimental Field of Division of Vegetable Science, SKUAST, Srinagar during 2010-11 to study the effect of sources and potassium application on growth, yield and quality of chili. The treatments comprising of four levels of potash viz., 30, 60, 90 and 120 kg K\(_2\)O ha\(^{-1}\). They observed that increasing levels of potash (120 kg ha\(^{-1}\)) significantly increased the fruit length, number of fruit plant\(^{-1}\) and dry fruit yield of chilli.
The experiment was conducted by Khan et al. (2014) during summer 2010-11 at the Agricultural Extension Department, Dargai Malakand, Pakistan to study the response of different level of nitrogen (0, 60, 120 and 180 kg N ha\(^{-1}\)) and potassium (0, 30, 40 and 50 kg K\(_2\)O ha\(^{-1}\)) on growth and yield of chilli. They reported that application of 180 kg N ha\(^{-1}\) and 40 kg K\(_2\)O ha\(^{-1}\) gave the maximum number of branches plant\(^{-1}\), fruits plant\(^{-1}\), fruit length and fruit yield.

A field experiment was carried out by Pushpavalli et al. (2014) at the Nellikuppam, Tamilnadu to study the effect of organic and inorganic potash fertilizers on growth and yield of okra. The result revealed that maximum number of green pod plant\(^{-1}\) and yield of green fruit recorded with the 150% RDK as compared to control.

### 2.2.3 EFFECT OF POTASH LEVELS ON QUALITY PARAMETERS

Mushtaq et al. (2014) conducted the field experiment at experimental field of division of vegetable science, SKUAST, Srinagar during 2010-11 to study the effect of sources and levels of potassium on growth, yield and quality of chili. The treatments comprising of four levels of potash \textit{viz.}, 30, 60, 90 and 120 kg K\(_2\)O ha\(^{-1}\). They observed that application of potash (120 kg ha\(^{-1}\)) gave significantly higher chorophyll content.

Nandal \textit{et al.}, (1998) carried out field experiment during 1990-91 at vegetable research farm of CCSHAU, Hissart to study the effect of levels of phosphorus and potassium (0, 40, 80 and 120 kg ha\(^{-1}\)) on growth,
yield and quality of tomato. From the results, they reported that quality parameters value increased with increase potash levels.

2.3. INTERACTION EFFECT OF NITROGEN AND POTASH LEVELS

2.3.1 INTERACTION EFFECT ON GROWTH AND YIELD ATTRIBUTES

Mani and Ramanathan (1980) conducted a field experiment at Department of Soil Science, Tamil Nadu Agricultural University, Coimbatore to study the effect of nitrogen and potassium on the yield of bhendi fruits. The treatments comprised of five level of nitrogen (0, 20, 40, 60 and 80 kg ha\(^{-1}\)) and five level of potash (0, 15, 30, 45 and 60 kg ha\(^{-1}\)). The interaction studies revealed that application of 80 kg ha\(^{-1}\) in combination with either 30 kg K\(_2\)O ha\(^{-1}\) or 60 kg ha\(^{-1}\) gave higher yield of okra.

Iqbal et al., (2011) conducted a field experiment at Agricultura Research Station, Mingora, Pakistan to study the effect of nitrogen and potassium on the yield of tomato. The treatments comprised of four level of nitrogen (0, 60, 40, 90 and 120 kg ha\(^{-1}\)) and three level of potash (90, 110 and 130 kg ha\(^{-1}\)). The interaction studies revealed that application of 120 kg N ha\(^{-1}\) in combination with 90 kg K\(_2\)O ha\(^{-1}\) gave higher yield of okra.

Bhuvaneswari et al. (2013) conducted field experiment at Research Farm of Botanical Garden, Department of Botany, Annamalai University, Tamilnadu during 2012 to study the effect of various levels of N (0, 25, 50
and 75) and potash (0, 30 and 60) on the growth and yield of chilli. They observed that maximum number of fruit/plant and yield of chilli obtained with combine application of 75 kg N ha\(^{-1}\) and 60 kg K\(_2\)O ha\(^{-1}\).
Materials

and

Methods
III. MATERIALS AND METHODS

The details of methods adopted, materials used and different observational techniques followed during the course of the investigation are described in this chapter.

3.1 EXPERIMENTAL SITE

The field experiment was conducted during kharif season of 2015 at the Main Vegetable Research Station, Anand Agricultural University, Anand.

3.2 CLIMATE AND WEATHER

Geographically, Anand is situated at 22º-35' N latitude and 72º-55' E longitude with an altitude of 45.1 m above mean sea level. Anand is about 70 km away from the Arabian Sea coast and hence, the climate of this region is semi-arid and sub-tropical with fairly dry and hot summer. Monsoon generally starts from June and retreats by middle of September with an annual rainfall of 884 mm, which is entirely from the South-West monsoon. Uncertain and uneven distribution of rainfall occurs during the monsoon in Anand district. July and August are the months of heavy precipitation. Temperature during most part of rainy season ranges from 22.2º C to 35.8º C. However, in the month of July, it ranges from 24.2º C to 35.7º C. Winter is fairly cold and sets in, in the month of November and continues till the middle of February. The lower temperatures are usually recorded in the months of September and October. Summer is hot and dry which commences from mid of February.
and ends by the month of June. July is the hottest month with mean maximum temperature around 40° C. The weekly mean observations of the meteorological parameters for the period of investigation during the 2015 recorded at the meteorological observatory of the Anand Agricultural University, Anand are presented in Table 3.1 and also graphically presented in Fig. 3.1. The maximum temperature ranged

**Table 3.1: Meteorological data recorded during crop season for the year 2015 (Weekly mean)**

<table>
<thead>
<tr>
<th>Month &amp; Year</th>
<th>Std. Met. Week</th>
<th>Date</th>
<th>Total rainfall (mm)</th>
<th>Average relative humidity (%)</th>
<th>Temperature °C</th>
<th>Sunshine hours day(^{-1})</th>
<th>Wind velocity km hr(^{-1})</th>
<th>Pan water evaporation (mm day(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>July, 2015</td>
<td>27</td>
<td>2-8</td>
<td>0.0</td>
<td>68</td>
<td>35.7</td>
<td>26.2</td>
<td>6.6</td>
<td>5.9</td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>9-15</td>
<td>0.0</td>
<td>64</td>
<td>35.7</td>
<td>26.3</td>
<td>4.7</td>
<td>5.1</td>
</tr>
<tr>
<td></td>
<td>29</td>
<td>16-22</td>
<td>1.1</td>
<td>76</td>
<td>34.3</td>
<td>25.9</td>
<td>2.9</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>23-29</td>
<td>296.2</td>
<td>91</td>
<td>29.6</td>
<td>23.6</td>
<td>0.6</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td>31</td>
<td>30-5</td>
<td>12.8</td>
<td>82</td>
<td>31.8</td>
<td>24.2</td>
<td>3.2</td>
<td>5.8</td>
</tr>
<tr>
<td>Aug., 2015</td>
<td>32</td>
<td>6-12</td>
<td>0.0</td>
<td>75</td>
<td>33.6</td>
<td>26.3</td>
<td>4.6</td>
<td>5.6</td>
</tr>
<tr>
<td></td>
<td>33</td>
<td>13-19</td>
<td>10.4</td>
<td>82</td>
<td>32.2</td>
<td>24.6</td>
<td>3.4</td>
<td>5.7</td>
</tr>
<tr>
<td></td>
<td>34</td>
<td>20-26</td>
<td>0.0</td>
<td>74</td>
<td>33.8</td>
<td>24.3</td>
<td>7.0</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td>35</td>
<td>27-2</td>
<td>0.9</td>
<td>76</td>
<td>34.2</td>
<td>24.4</td>
<td>6.8</td>
<td>5.6</td>
</tr>
<tr>
<td>Sept., 2015</td>
<td>36</td>
<td>3-9</td>
<td>0.0</td>
<td>73</td>
<td>34.8</td>
<td>23.1</td>
<td>9.6</td>
<td>5.2</td>
</tr>
<tr>
<td></td>
<td>37</td>
<td>10-16</td>
<td>0.0</td>
<td>73</td>
<td>35.8</td>
<td>24.4</td>
<td>7.7</td>
<td>3.8</td>
</tr>
<tr>
<td></td>
<td>38</td>
<td>17-23</td>
<td>75.6</td>
<td>87</td>
<td>31.9</td>
<td>23.6</td>
<td>3.4</td>
<td>6.0</td>
</tr>
<tr>
<td></td>
<td>39</td>
<td>24-30</td>
<td>0.0</td>
<td>71</td>
<td>33.0</td>
<td>22.2</td>
<td>9.4</td>
<td>7.2</td>
</tr>
<tr>
<td>Oct., 2015</td>
<td>40</td>
<td>1-7</td>
<td>0.0</td>
<td>64</td>
<td>37.0</td>
<td>21.9</td>
<td>9.4</td>
<td>3.2</td>
</tr>
<tr>
<td></td>
<td>41</td>
<td>8-14</td>
<td>0.0</td>
<td>63</td>
<td>37.7</td>
<td>22.4</td>
<td>9.2</td>
<td>2.4</td>
</tr>
</tbody>
</table>
Figure 3.1: Meteorological data recorded during crop season for the year 2015 (Weekly mean)
between 29.6 to 37.7 °C and minimum temperature ranged between 21.9 to 26.3 °C during the crop season of the year 2015. The seasonal rainfall ranged from 0.9 to 296.2 mm during standard meteorological weeks of crop season, but no any adverse effect on the crop. The other weather parameters viz., relative humidity, wind velocity, daily evaporation and sunshine hours were normal. In general, the weather conditions were congenial during the crop season.

### 3.3 SOIL CHARACTERISTICS

Experimental site had an even topography with moderate slope and good drainage. The soil is representative of the soils of the region, popularly known as 'Goradu' soil. It is alluvial in origin, light brown in colour, well drained, fairly retentive of moisture, low in organic matter and belongs to the order Alfisol. The texture of the soil is loamy sand. The soil is very deep and responds well to manuring and variety of crops of the tropical and sub-tropical regions. The ground water table was more than 10 m in depth. Composite soil samples were collected from the experimental site upto a depth of 0-15 cm before commencement of the experiment and were analyzed for the various physico-chemical properties, details of which are presented in the Table 3.2.

### 3.4 CROPPING HISTORY OF THE EXPERIMENTAL SITE

The cropping history of the experimental site for preceding two years is presented in Table 3.3.
Table 3.2: Physico-chemical properties of soil of the experimental plot (initial)

<table>
<thead>
<tr>
<th>Particular</th>
<th>Soil depth</th>
<th>Method of analysis</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-15 cm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Physical properties

<table>
<thead>
<tr>
<th>Particular</th>
<th>Soil depth</th>
<th>Method of analysis</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course sand (%)</td>
<td>0.57</td>
<td>International pipette method</td>
<td>(Piper, 1950)</td>
</tr>
<tr>
<td>Fine sand (%)</td>
<td>83.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silt (%)</td>
<td>10.85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clay (%)</td>
<td>5.54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Textural class</td>
<td>Loamy sand</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Chemical properties

<table>
<thead>
<tr>
<th>Particular</th>
<th>Soil depth</th>
<th>Method of analysis</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC (1:2.5) (dS m⁻¹)</td>
<td>0.51</td>
<td>Conductivity meter</td>
<td>(Jackson, 1973)</td>
</tr>
<tr>
<td>Soil pH (1:2.5)</td>
<td>7.7</td>
<td>Potentiometry method</td>
<td>(Jackson, 1973)</td>
</tr>
<tr>
<td>Organic carbon (%)</td>
<td>0.46</td>
<td>Walkley &amp; Black’s titration method</td>
<td>Walkley &amp; Black (1934)</td>
</tr>
<tr>
<td>Available N (kg ha⁻¹)</td>
<td>228.86</td>
<td>Alkaline potassium permanganate method</td>
<td>(Subbiah and Assija, 1956)</td>
</tr>
<tr>
<td>Available P₂O₅ (kg ha⁻¹)</td>
<td>43.86</td>
<td>Olsen’s method (Spectrophotometric)</td>
<td>(Olsen et al., 1954)</td>
</tr>
<tr>
<td>Available K₂O (kg ha⁻¹)</td>
<td>230.30</td>
<td>Flame photometric method</td>
<td>(Jackson, 1973)</td>
</tr>
</tbody>
</table>
Table 3.3: Cropping history of the experimental field

<table>
<thead>
<tr>
<th>Year</th>
<th>Season</th>
<th>Crop</th>
<th>Fertilizer (kg ha(^{-1})) applied</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>N</td>
</tr>
<tr>
<td>2012-13</td>
<td>Kharif</td>
<td>Okra</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Rabi</td>
<td>Chilli</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>Summer</td>
<td>Fallow</td>
<td>-</td>
</tr>
<tr>
<td>2013-14</td>
<td>Kharif</td>
<td>Tomato</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>Rabi</td>
<td>Brinjal</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Summer</td>
<td>Fallow</td>
<td>-</td>
</tr>
<tr>
<td>2014-15</td>
<td>Kharif</td>
<td>Present Experiment on Okra</td>
<td>As per treatment</td>
</tr>
</tbody>
</table>

3.5 CROP AND VARIETY

Okra (Gujarat Anand Okra-5) used in the present experiment was breed at the Main Vegetable Research Station, Anand Agricultural University, Anand and released in the year 2011. The variety is recommended for cultivation in the Middle Gujarat condition. This genotype was selected from the cross VRO 6 × AOL 00-6 made during kharif 2002 followed by pedigree method of breeding. Moreover, it is resistant to yellow Vein Mosaic under field condition. The fruits are medium sized, dark green coloured, tender and attractive.
Table 3.4: Characteristics of okra variety Gujarat Anand Okra-5

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Characters</th>
<th>GAO-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Days to flowering</td>
<td>43.4</td>
</tr>
<tr>
<td>2</td>
<td>Days to first picking</td>
<td>50.1</td>
</tr>
<tr>
<td>3</td>
<td>Plant height (cm)</td>
<td>140.00</td>
</tr>
<tr>
<td>4</td>
<td>Primary branches plant⁻¹</td>
<td>3.67</td>
</tr>
<tr>
<td>5</td>
<td>Number of nodes plant⁻¹</td>
<td>17.33</td>
</tr>
<tr>
<td>6</td>
<td>Internodes length (cm)</td>
<td>8.08</td>
</tr>
<tr>
<td>7</td>
<td>Petiole length (cm)</td>
<td>27.67</td>
</tr>
<tr>
<td>8</td>
<td>Length of middle leaf node (cm)</td>
<td>22.00</td>
</tr>
<tr>
<td>9</td>
<td>Penduncle length (cm)</td>
<td>2.93</td>
</tr>
<tr>
<td>10</td>
<td>Fruit length (cm)</td>
<td>14.02</td>
</tr>
<tr>
<td>11</td>
<td>Fruit girth (cm)</td>
<td>5.75</td>
</tr>
<tr>
<td>12</td>
<td>Fruit weight (cm)</td>
<td>19.05</td>
</tr>
<tr>
<td>13</td>
<td>Fruits plant⁻¹</td>
<td>22.33</td>
</tr>
<tr>
<td>14</td>
<td>Number of seeds fruit⁻¹</td>
<td>55.33</td>
</tr>
<tr>
<td>15</td>
<td>100- seed weight (g)</td>
<td>7.14</td>
</tr>
</tbody>
</table>

3.6 EXPERIMENTAL DETAILS

With a view to study the effect of nitrogen and potash levels on growth and green fruit yield of okra (GAO-5), an experiment was conducted during kharif season of the year 2015. The details of the experiment are given below.

3.6.1 Treatments

Twenty treatment combinations involving four levels of nitrogen and five levels of potash were included in the experiment. The details of treatments are as follows:
Materials and methods

(A) Nitrogen levels (N)

- $N_1$: 75 kg N ha$^{-1}$
- $N_2$: 100 kg N ha$^{-1}$
- $N_3$: 125 kg N ha$^{-1}$
- $N_4$: 150 kg N ha$^{-1}$

(B) Potash levels (K)

- $K_1$: 25 kg ha$^{-1}$
- $K_2$: 50 kg ha$^{-1}$
- $K_3$: 75 kg kg hA$^{-1}$
- $K_4$: 25 kg ha$^{-1}$ as basal + 25 kg ha$^{-1}$ at 45 DAS
- $K_5$: 37.5 kg ha$^{-1}$ as basal + 37.5 kg ha$^{-1}$ at 45 DAS

(Note: Application of nitrogen 25 % as basal, 25 % at 30 DAS, 25 % at 45 DAS and 25 % at 60 DAS as well as 50 kg P$_2$O$_5$ in all the treatments at basal.)

3.6.2 Treatment combinations

There were twenty treatment combinations as given in Table 3.5.

3.6.3 Experimental design and layout

Randomized Block Design with factorial concept was adopted for this study, wherein, nitrogen and potash levels comprising of twenty treatment combinations were assigned with three replications. The plan of layout is depicted in Fig. 3.2 and plate 1.
Plate 1: General view of experimental plot
Layout plan of the experimental site

Gross plot size : 3.6 m x 6.0 m
Net plot size : 2.4 m x 5.4 m
### Materials and methods

**Table 3.5: Details of the treatment combinations**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Treatment Symbol</th>
<th>Treatment combination</th>
<th>Nitrogen (kg ha(^{-1}))</th>
<th>Potash (kg ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N(_1)K(_1)</td>
<td></td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>N(_1)K(_2)</td>
<td></td>
<td>75</td>
<td>50</td>
</tr>
<tr>
<td>3</td>
<td>N(_1)K(_3)</td>
<td></td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>4</td>
<td>N(_1)K(_4)</td>
<td></td>
<td>75</td>
<td>25 kg ha(^{-1}) as basal + 25 kg ha(^{-1}) (45 DAS)</td>
</tr>
<tr>
<td>5</td>
<td>N(_1)K(_5)</td>
<td></td>
<td>75</td>
<td>37.5 kg ha(^{-1}) as basal + 37.5 kg ha(^{-1}) (45 DAS)</td>
</tr>
<tr>
<td>6</td>
<td>N(_2)K(_1)</td>
<td></td>
<td>100</td>
<td>25</td>
</tr>
<tr>
<td>7</td>
<td>N(_2)K(_2)</td>
<td></td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>8</td>
<td>N(_2)K(_3)</td>
<td></td>
<td>100</td>
<td>75</td>
</tr>
<tr>
<td>9</td>
<td>N(_2)K(_4)</td>
<td></td>
<td>100</td>
<td>25 kg ha(^{-1}) as basal + 25 kg ha(^{-1}) (45 DAS)</td>
</tr>
<tr>
<td>10</td>
<td>N(_2)K(_5)</td>
<td></td>
<td>100</td>
<td>37.5 kg ha(^{-1}) as basal + 37.5 kg ha(^{-1}) (45 DAS)</td>
</tr>
<tr>
<td>11</td>
<td>N(_3)K(_1)</td>
<td></td>
<td>125</td>
<td>25</td>
</tr>
<tr>
<td>12</td>
<td>N(_3)K(_2)</td>
<td></td>
<td>125</td>
<td>50</td>
</tr>
<tr>
<td>13</td>
<td>N(_3)K(_3)</td>
<td></td>
<td>125</td>
<td>75</td>
</tr>
<tr>
<td>14</td>
<td>N(_3)K(_4)</td>
<td></td>
<td>125</td>
<td>25 kg ha(^{-1}) as basal + 25 kg ha(^{-1}) (45 DAS)</td>
</tr>
<tr>
<td>15</td>
<td>N(_3)K(_5)</td>
<td></td>
<td>125</td>
<td>37.5 kg ha(^{-1}) as basal + 37.5 kg ha(^{-1}) (45 DAS)</td>
</tr>
<tr>
<td>16</td>
<td>N(_4)K(_1)</td>
<td></td>
<td>150</td>
<td>25</td>
</tr>
<tr>
<td>17</td>
<td>N(_4)K(_2)</td>
<td></td>
<td>150</td>
<td>50</td>
</tr>
<tr>
<td>18</td>
<td>N(_4)K(_3)</td>
<td></td>
<td>150</td>
<td>75</td>
</tr>
<tr>
<td>19</td>
<td>N(_4)K(_4)</td>
<td></td>
<td>150</td>
<td>25 kg ha(^{-1}) as basal + 25 kg ha(^{-1}) (45 DAS)</td>
</tr>
<tr>
<td>20</td>
<td>N(_4)K(_5)</td>
<td></td>
<td>150</td>
<td>37.5 kg ha(^{-1}) as basal + 37.5 kg ha(^{-1}) (45 DAS)</td>
</tr>
</tbody>
</table>
3.6.4 Other details

Other details regarding the investigation are as follows.

Seed rate : 8 kg ha\(^{-1}\)

Fertilizer :

- N : As per treatment
- P\(_2\)O\(_5\) : 50 kg ha\(^{-1}\)
- K\(_2\)O : As per treatment

Spacing : 60 × 30 cm

Plot Size :

- (A) Gross Plot : 3.6 m x 6.0 m
- (B) Net Plot : 2.4 m x 5.4 m

Total No. of plots : 60

Crop & variety :

- (A) Crop : Okra
- (B) Variety : GAO-5
- (C) Method of Sowing: Dibbling

Sowing date : 4 July, 2015

3.7 CULTURAL OPERATIONS

All essential cultural operations i.e. cross cultivation by tractor, planking, opening of furrows etc. were done in the field where experiment was conducted. The details of operations and their sequence are given in Table 3.6.
3.7.1  **Land preparation**

The field was cross cultivated with tractor followed by planking to level it. The experiment was laid out as per lay out plan and plots were leveled manually to open the furrow. Plots were marked as per the spacing with the help of iron marker to dibble the seeds.

3.7.2  **Fertilizer application**

The crop was fertilized as per respective nitrogen @ 75, 100, 125 and 150 kg N ha\(^{-1}\) and potash @ 25, 50, 75, 50 and 75 kg K\(_2\)O ha\(^{-1}\) in the respective plots as per treatments. The 25% quantity of nitrogen was given as a basal dose at the time of preparation of land and remaining quantities was applied as top dressing at around 30, 45 and 60 days after sowing. Entire quantity of phosphorus (50 kg ha\(^{-1}\)) were applied as a common basal dose in furrow to all the plots in form of single super phosphate. The furrows were lightly covered with soil.

3.7.3  **Seeds and sowing of crop**

The seeds of GAO-5 variety of okra were dibbled in previously opened furrows at a distance of 60 cm between and 30 cm within the row @ 6 kg seeds ha\(^{-1}\) respectively. Two seeds per hill were dibbled at a depth of around 3 cm.

3.7.4  **Gap filling**

The plant population was maintained by gap filling keeping one plant per hill.
### Table 3.6: Calendar of cultural operations

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Field operation</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td><strong>Pre-sowing operations</strong></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Cross cultivation by tractor and planking by pair of bullock</td>
<td>03-07-15</td>
</tr>
<tr>
<td>2.</td>
<td>Preparation of layout and marking</td>
<td>04-07-15</td>
</tr>
<tr>
<td>3.</td>
<td>Opening of furrow</td>
<td>04-07-15</td>
</tr>
<tr>
<td>4.</td>
<td>Basal fertilizer application</td>
<td>04-07-15</td>
</tr>
<tr>
<td>5.</td>
<td>Covering of furrow</td>
<td>04-07-15</td>
</tr>
<tr>
<td>6.</td>
<td>Seed treatment with Imidaclopride</td>
<td>04-07-15</td>
</tr>
<tr>
<td>B.</td>
<td><strong>Sowing and post-sowing operations</strong></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Dibbling of seeds</td>
<td>04-07-15</td>
</tr>
<tr>
<td>2.</td>
<td>Gap filling</td>
<td>13-07-15</td>
</tr>
<tr>
<td>3.</td>
<td>Top dressing of N fertilizer as per treatments</td>
<td>03-08-15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17-08-15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>01-09-15</td>
</tr>
<tr>
<td>4.</td>
<td>Top dressing of potash fertilizer as per treatments</td>
<td>17-08-15</td>
</tr>
<tr>
<td>5.</td>
<td>Irrigation</td>
<td>04-07-15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13-07-15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>31-08-15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13-09-15</td>
</tr>
<tr>
<td>6.</td>
<td>Hand weeding</td>
<td>17-07-15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>03-08-15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25-08-15</td>
</tr>
<tr>
<td>6.</td>
<td>Interculturing</td>
<td>17-08-15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19-09-15</td>
</tr>
<tr>
<td>7.</td>
<td>Pesticide application</td>
<td>23-07-15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22-08-15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>07-09-15</td>
</tr>
<tr>
<td>8.</td>
<td>Picking of pods</td>
<td>29-08-15</td>
</tr>
</tbody>
</table>
3.7.5 Irrigation

The crop was irrigated as and when required by crop depending upon weather situation.

3.7.6 Plant protection

During the grand growth period, the crop was attacked by jassids, whitefly and fruit and shoot borer, but they were effectively controlled by seed treatment with Imidacloprid, application of Quinalphos and Dimethoate as per the recommended quantity of insecticide.
3.7.7 Harvesting

The okra fruits from randomly selected plants were harvested separately for taking observations. The fruits from the net plot were picked separately and weighed. The okra fruits were picked continuously at alternate days after the first picking.

3.8 Biometric Observations

The biometric observations were recorded from five randomly selected plants tagged in each net plot.

The details of various growth parameters, yield attributes and chemical parameters studied during the course of investigation are given in Table 3.7. Details of the techniques followed for recording observations are described below.

3.8.1 Plant population

Plant population at initial and harvest was recorded by counting the number of plants in each net plot.

3.8.2 Growth attributes

3.8.2.1 Plant height (cm)

Five plants were randomly selected and tagged for easy recognition and observations in each net experimental plot. The height was measured in centimetre at 30 DAS and at harvest from ground level to the upper
most leaf. The mean height per plant was worked out and recorded separately for each treatment.

Table 3.7: Parameters studied during the course of investigation

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Characters</th>
<th>Sample size</th>
<th>Time of recording</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Plant stand per net plot</td>
<td>Count all plant</td>
<td>Initial and at harvest</td>
</tr>
<tr>
<td>2.</td>
<td><strong>Growth attributes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i.</td>
<td>Plant height</td>
<td>Randomly selected 5 plants plot⁻¹</td>
<td>30 DAS and at harvest</td>
</tr>
<tr>
<td>ii.</td>
<td>Days to initiation of flowering</td>
<td>Net plot</td>
<td>As and when observed under field condition</td>
</tr>
<tr>
<td>iii.</td>
<td>Number of branches plant⁻¹</td>
<td>Randomly selected 5 plants plot⁻¹</td>
<td>At harvest</td>
</tr>
<tr>
<td>3.</td>
<td><strong>Yield attributes and yield</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i.</td>
<td>Number of pods plant⁻¹</td>
<td>Randomly selected 5 plants plot⁻¹</td>
<td>Per picking</td>
</tr>
<tr>
<td>ii.</td>
<td>Length of pod (cm)</td>
<td>Randomly selected 5 pods</td>
<td>Per picking</td>
</tr>
<tr>
<td>iii.</td>
<td>Girth of pod (cm)</td>
<td>Randomly selected 5 pods</td>
<td>Per picking</td>
</tr>
<tr>
<td>iv.</td>
<td>Weight of pod plant⁻¹</td>
<td>Randomly selected 5 pods</td>
<td>Per picking</td>
</tr>
<tr>
<td>v.</td>
<td>Total green pod yield (kg ha⁻¹)</td>
<td>As per procedure</td>
<td>Per picking</td>
</tr>
<tr>
<td>4.</td>
<td><strong>Chemical parameters</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>Organic carbon status of soil (%)</td>
<td>As per procedure</td>
<td>Initial and at harvest</td>
</tr>
<tr>
<td>b.</td>
<td>Available nitrogen status of soil (kg ha⁻¹)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>Available phosphorus status of soil (kg ha⁻¹)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td>Available potassium status of soil (kg ha⁻¹)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td><strong>Plant chemical parameters</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>Nitrogen content</td>
<td>Random sample from each net plot</td>
<td>After harvest</td>
</tr>
<tr>
<td>b.</td>
<td>Phosphorus content</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>Potash content</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.8.2.2 Days to initiation of flowering

The Number of days was counted from the date of sowing to the date of emergence of first flowers in all net plots and recorded separately.

3.8.2.3 Number of branches plant$^{-1}$

Number of branches plant$^{-1}$ was measured at harvest from previously randomly selected tagged five plants and recorded separately.

3.8.3 Yield attributes and yield

3.8.3.1 Number of pods plant$^{-1}$

Number of pods plant$^{-1}$ was counted at each picking from randomly selected tagged five plants and mean values of pods plant$^{-1}$ was worked out and recorded separately and total number of pod plant$^{-1}$ are used for statistical analysis.

3.8.3.2 Length of pod (cm)

The pods from the same randomly selected and tagged five plants were used for studying length of pod. Length of five pods was measured in centimetre. By this method, length of five pods was determined mean was worked out and finally work out average of all picking and recorded separately.

3.8.3.3 Girth of pod (cm)

The pods of the same randomly selected five plants were used to measure the average girth of pod in centimeter. Ordinary string (thread)
was used for measuring the girth. The thread was wrapped around the pod and the length of thread was measured in cm. By this method, girth of five pods was determined mean was worked out and finally work out average of all picking and recorded separately.

3.8.3.4 **Weight of pod plant\(^1\) (g)**

Five pods previously used for measuring length and girth were recorded on single pan balance and average weight per fruit in gram was worked out.

3.8.3.5 **Green pod yield (q ha\(^{-1}\))**

Green pods from all the plants of each net plot were harvested separately during the each pickings and finally sumup of all the picking yield from the net plot and weighed. The green pod yield of net plot is converted into hectare base.

3.8.4 **Quality parameters**

3.8.4.1 **Moisture (%)**

Moisture content of okra fruits was determined by drying the weighed sample of okra fruits at 105° C in hot air oven for 5 hours and the loss of weight was expressed as moisture content. Five gram fruit sample was taken in pre-weighed petriplates and calculate the moisture by the following formula.

\[
\text{Moisture (\%)} = \frac{(\text{Fresh Weight} - \text{Dry Weight})}{\text{Fresh Weight}} \times 100
\]
3.8.4.2  Mucilage (mg g⁻¹)

The okra fruits were homogenized with five times its weight of water, centrifuged at 4000 g for 15 min and the clear, viscous solution determined. The solutions was heated at 70° C for 5 min to inactive enzymes and recentrifuged. The mucilage was precipitated with three volumes of ethanol and washed with more ethanol followed by acetone. The cream coloured solid was dried under the vacuum (less than one Torr at 25° C for 12 hours) and weighed (Woolfe et al.).

3.8.4.3  Total chlorophyll content (mg g⁻¹)

Chlorophyll was estimated by method described by Hiscox and Israelstam (1979). Hundred mg fresh fruits were cut into small pieces and kept in dimethyl sulfoxide (DMSO) containing tube over night. The extract was filtered through whatman No. 1 filter paper. Filtrate was collected and volume made to 10 ml with DMSO. Absorbance was measured in spectrophotometer at 645 nm and 663 nm for determination of total chlorophyll, and content was calculated by following equation:

\[
\text{Chlorophyll a (mg/g fresh tissue)} = \frac{12.2(A_{645}) - 2.69(A_{645})}{axWx1000} xV
\]

\[
\text{Chlorophyll b (mg/g fresh tissue)} = \frac{22.9(A_{645}) - 4.68(A_{643})}{axWx1000} xV
\]

\[
\text{Total Chlorophyll b (mg/g fresh tissue)} = \frac{20.2(A_{645}) + 8.02(A_{633})}{axWx1000} xV
\]
Where

\[ A_{663} = \text{Absorbance at 663 nm} \]

\[ A_{645} = \text{Absorbance at 645 nm} \]

\[ a = \text{length of light path in the cell (usually 10 mm)} \]

\[ V = \text{Volume of the extract in ml} \]

\[ W = \text{Fresh weight of sample in gm} \]

### 3.8.5 Chemical parameters

#### 3.8.5.1 Chemical analysis of initial soil samples and after harvest of crops.

To know the initial and after harvest nutrient status of the soil, soil samples were collected from the experimental plot area. These samples were air dried, ground and passed through 2 mm sieve and were analyzed for nutrient status by adopting methods as indicated in Table 3.2.

#### 3.8.5.2 Nutrients content (N, P and K) in plant

Representative samples of plants were taken from each plot for chemical analysis. They were oven dried at 70° C for 24 hrs and powdered in a mechanical grinder for the estimation of N, P and K content by following standard methods. Estimation of total nitrogen was done by modified Kjeldhal's method as described by Jackson (1973). Estimation of phosphorus was done by Vanadomolybdophosphoric acid yellow colour method as described by Jackson (1973). Estimation of
potassium was made from acid extract by Flame photometer method as described by Jackson (1973).

3.9 STATISTICAL ANALYSIS

The statistical analysis of the data generated during the course of investigation was carried out on computerized system as per the procedure described by Cochran and Cox (1967). The significant were tested by “F-test” and compared with the value of Table F at 5% level of significance. The value of S.Em. and C.V.% were also worked out.

3.10. ECONOMICS

In order to evaluate the efficiency of each treatment combination, economics was worked out in terms of net profit so that the most economic and remunerative treatment combination could be decided.

The cost of cultivation of crop under individual treatment was worked out by taking into consideration the cost of all the cultivation operations from preparatory tillage till harvesting of the crop including the cost of all necessary inputs.

The gross realization in terms of rupees per hectare was worked out taking into consideration the yield of each treatment and prevailing market price. The net profit was worked out by deducting the total cost of cultivation from gross realization for each treatment and recorded accordingly.
The benefit: cost ratio (BCR) for each treatment was calculated on the basis of formula given below.

$$\text{BCR} = \frac{\text{Net realization (₹ ha}^{-1})}{\text{Total expenditure (₹ ha}^{-1})}$$
Experimental Results
IV. EXPERIMENTAL RESULTS

The result obtained from the present investigation entitled “Effect of nitrogen and potash levels on growth and green fruit yield of okra (Abelmoschus esculentus L. Moench) during kharif season under middle Gujarat conditions” conducted at the Main Vegetable Research Station, Anand Agricultural University, Anand are presented in this chapter. Data pertaining to the effects of different treatments on growth attributes, yield attributes, yield and chemical parameters were subjected to statistical analysis in order to test the significance of results. The results obtained in the present investigation are presented here under following heads.

4.1 EFFECT OF TREATMENTS ON PLANT POPULATION
4.2 EFFECT OF TREATMENTS ON GROWTH ATTRIBUTES
4.3 EFFECT OF TREATMENTS ON YIELD ATTRIBUTES AND YIELD
4.4 EFFECT OF TREATMENTS ON QUALITY PARAMETERS
4.5 EFFECT OF TREATMENTS ON CHEMICAL PARAMETERS
4.6 EFFECT OF TREATMENTS ON ECONOMICS

4.1 EFFECT OF TREATMENTS ON PLANT POPULATION

Data on plant population per net plot recorded at initial and at harvest of the crop as influenced by different levels of nitrogen and potash are presented in Table 4.1.
Table 4.1: Plant population recorded at 30 DAS and at harvest as influenced by different levels of nitrogen and potash

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Plant population net plot$^{-1}$</th>
<th>At 30 DAS</th>
<th>At harvest</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nitrogen levels (kg ha$^{-1}$)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N$_1$ = 75</td>
<td>68</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td>N$_2$ = 100</td>
<td>69</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td>N$_3$ = 125</td>
<td>69</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td>N$_4$ = 150</td>
<td>70</td>
<td>64</td>
<td></td>
</tr>
<tr>
<td>SEM±</td>
<td>1.07</td>
<td>1.12</td>
<td></td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td><strong>Potash levels (kg ha$^{-1}$)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K$_1$ = 25</td>
<td>69</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td>K$_2$ = 50</td>
<td>69</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td>K$_3$ = 75</td>
<td>69</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td>K$_4$ = 25 at basal + 25 at 45 DAS</td>
<td>69</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td>K$_5$ = 37.5 at basal + 37.5 at 45 DAS</td>
<td>70</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td>SEM±</td>
<td>1.19</td>
<td>1.25</td>
<td></td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td><strong>N×K interaction</strong></td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>CV %</td>
<td>6.02</td>
<td>6.98</td>
<td></td>
</tr>
</tbody>
</table>

4.1.1 **Effect of nitrogen levels**

Analysis of data (Table 4.1) showed that different levels of nitrogen did not exert any significant influence on the plant population. It was indicated
that plant population at 30 DAS and at harvest of the crop were numerically highest in treatment N₄ (150 kg N ha⁻¹).

4.1.2 Effect of potash levels

A perusal of data presented in Table 4.1 revealed that the differences in plant population due to different levels of potash were found non-significant at 30 DAS and at harvest of the crop.

4.1.3 Interaction effect

Interaction effect of different levels of nitrogen and potash did not manifest significant effect with respect to plant population of okra recorded at 30 DAS and at harvest (Table 4.1).

4.2 EFFECT OF TREATMENTS ON GROWTH ATTRIBUTES

4.2.1 Plant height (cm)

Data on plant height measured at 30 DAS and at harvest of the crop as influenced by different levels of nitrogen and potash are given in Table 4.2 and also depicted graphically in Fig. 4.1.

4.2.1.1 Effect of nitrogen levels

Data presented in Table 4.2 revealed that differences in plant height measured at harvest were significantly increased with increase in nitrogen levels. Whereas, plant height measured at 30 DAS were not influenced significantly by nitrogen levels. The higher values of plant height (140 cm) at harvest were noted under application of 150 kg N ha⁻¹ (N₄). However, it was at par with 125 kg N ha⁻¹ (N₃). Treatment N₁ (75 kg N ha⁻¹) lagged behind all by recording the lowest values of plant height at both the growth periods.
Table 4.2: Plant height recorded at 30 and at harvest as influenced by nitrogen and potash levels

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Plant height (cm)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30 DAS</td>
<td>At harvest</td>
<td></td>
</tr>
<tr>
<td>Nitrogen levels (kg ha(^{-1}))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N(_1) = 75</td>
<td>36.54</td>
<td>85.33</td>
<td></td>
</tr>
<tr>
<td>N(_2) = 100</td>
<td>38.32</td>
<td>110.26</td>
<td></td>
</tr>
<tr>
<td>N(_3) = 125</td>
<td>39.16</td>
<td>131.91</td>
<td></td>
</tr>
<tr>
<td>N(_4) = 150</td>
<td>40.11</td>
<td>140.00</td>
<td></td>
</tr>
<tr>
<td>SEm±</td>
<td>0.90</td>
<td>3.72</td>
<td></td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>NS</td>
<td>10.66</td>
<td></td>
</tr>
<tr>
<td>Potash levels (kg ha(^{-1}))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K(_1) = 25</td>
<td>38.14</td>
<td>108.54</td>
<td></td>
</tr>
<tr>
<td>K(_2) = 50</td>
<td>38.44</td>
<td>115.22</td>
<td></td>
</tr>
<tr>
<td>K(_3) = 75</td>
<td>39.47</td>
<td>118.21</td>
<td></td>
</tr>
<tr>
<td>K(_4) = 25 at basal + 25 at 45 DAS</td>
<td>38.20</td>
<td>119.65</td>
<td></td>
</tr>
<tr>
<td>K(_5) = 37.5 at basal + 37.5 at 45 DAS</td>
<td>38.41</td>
<td>122.76</td>
<td></td>
</tr>
<tr>
<td>SEm±</td>
<td>1.01</td>
<td>4.17</td>
<td></td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>N×K interaction</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>CV %</td>
<td>9.10</td>
<td>12.34</td>
<td></td>
</tr>
</tbody>
</table>

4.2.1.2 Effect of potash levels

Data presented in Table 4.2 showed that the effect of different levels of potash was found non significant with respect to plant height at 30 DAS and
Figure 4.1: Mean plant height (cm) at 30 DAS and at harvest as influenced by different levels of nitrogen and potash.
at harvest. The numerically value of plant height at harvest under the treatment $K_1$, $K_2$, $K_3$, $K_4$, and $K_5$ were 108.54, 115.22, 118.21, 119.65 and 122.76 cm, respectively.

4.2.1.3 Interaction effect

The interaction effect of different levels of nitrogen and potash was found non-significant with respect to plant height measured at 30 DAS and at harvest. (Table 4.2)

4.2.2 Days to initiation of flowering

Data on the days to initiation of flowering as influenced by different levels of nitrogen and potash are presented in Table 4.3.

4.2.2.1 Effect of nitrogen levels

Analysis of data given in Table 4.3 further showed that nitrogen levels had significant influence on days to initiation of flowering. Application of 150 kg N ha$^{-1}$ ($N_4$) being at par with treatment $N_3$ (125 kg N ha$^{-1}$) and $N_2$ (100 kg N ha$^{-1}$), recorded significantly more number of days to initiation of flowering than lower levels of nitrogen 75 kg N ha$^{-1}$ ($N_1$). The values of days to initiation of flowering under treatments were in the order of $N_1 < N_2 < N_3 < N_4$.

4.2.2.2 Effect of potash levels

It is evident from the data given in Table 4.3 that overall effect of different levels of potash on days to initiation of flowering was found non-significant. The values of days to initiation of flowering under treatments $K_1$, $K_2$ and $K_3$, $K_4$, $K_5$ were 42.79, 43.07, 43.72, 43.20 and 43.61 days, respectively.
### Results

Table 4.3: Days to initiation of flowering and number of branches plant\(^{-1}\) at harvest as influenced by nitrogen and potash levels

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Days to initiation of flowering</th>
<th>Number of branches plant(^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nitrogen levels (kg ha(^{-1}))</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N(_1) = 75</td>
<td>41.47</td>
<td>2.39</td>
</tr>
<tr>
<td>N(_2) = 100</td>
<td>43.19</td>
<td>3.90</td>
</tr>
<tr>
<td>N(_3) = 125</td>
<td>43.77</td>
<td>4.86</td>
</tr>
<tr>
<td>N(_4) = 150</td>
<td>44.69</td>
<td>5.12</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.57</td>
<td>0.10</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>1.64</td>
<td>0.29</td>
</tr>
<tr>
<td><strong>Potash levels (kg ha(^{-1}))</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K(_1) = 25</td>
<td>42.79</td>
<td>3.63</td>
</tr>
<tr>
<td>K(_2) = 50</td>
<td>43.07</td>
<td>3.98</td>
</tr>
<tr>
<td>K(_3) = 75</td>
<td>43.72</td>
<td>4.04</td>
</tr>
<tr>
<td>K(_4) = 25 at basal + 25 at 45 DAS</td>
<td>43.20</td>
<td>4.18</td>
</tr>
<tr>
<td>K(_5) = 37.5 at basal + 37.5 at 45 DAS</td>
<td>43.61</td>
<td>4.31</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.64</td>
<td>0.11</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>NS</td>
<td>0.33</td>
</tr>
<tr>
<td><strong>N×K interaction</strong></td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td><strong>CV %</strong></td>
<td>5.15</td>
<td>9.71</td>
</tr>
</tbody>
</table>
4.2.2.3 Interaction effect

The interaction effect between different levels of nitrogen and potash was found absent with respect to days to initiation of flowering (Table 4.3).

4.2.3 Number of branches plant\(^{-1}\) at harvest

Data on number of branches plant\(^{-1}\) at harvest as influenced by different levels of nitrogen and potash are presented in Table 4.3.

4.2.3.1 Effect of nitrogen levels

A evident from the data presented in Table 4.3 indicated that various treatments of nitrogen levels showed perceptible variation in the number of branches plant\(^{-1}\). Application of 150 kg N ha\(^{-1}\) (\(N_4\)) recorded significantly the higher number of branches plant\(^{-1}\) (5.12). However, it was at par with application of 125 kg N ha\(^{-1}\) (\(N_3\)). While, application of 75 kg N ha\(^{-1}\) (\(N_1\)) recorded the lowest number of branches plant\(^{-1}\) as compared to rest of the treatments.

4.2.3.2 Effect of potash levels

Data presented in Table 4.3 showed that the effect of different levels of potash was found significant with respect to number of branches plant\(^{-1}\). Among different potash levels, higher number of branches plant\(^{-1}\) (4.31) was obtained under treatment \(K_5\) (37.5 kg K\(_2\)O ha\(^{-1}\) at basal + 37.5 kg K\(_2\)O ha\(^{-1}\) at 45 DAS), which was remained at par with the treatment \(K_4\) (25 kg K\(_2\)O ha\(^{-1}\) at basal + 25 kg K\(_2\)O ha\(^{-1}\) at 45 DAS) and treatment \(K_3\) (75 kg K\(_2\)O ha\(^{-1}\)). Treatment \(K_1\) (25 kg K\(_2\)O ha\(^{-1}\)) recorded the significantly lower number of branches plant\(^{-1}\) (3.63).
4.2.3.3 Interaction effect

The interaction effect of different levels of nitrogen and potash was found non-significant with respect to number of branches plant$^{-1}$ (Table 4.3).

4.3 YIELD ATTRIBUTES AND YIELD

4.3.1 Number of pods plant$^{-1}$

Data pertaining to number of pods plant$^{-1}$ as influenced by different levels of nitrogen and potash are presented in (Table 4.4, 4.5 and 4.6) and also depicted graphically in Fig. 4.2.

4.3.1.1 Effect of nitrogen levels

The data presented in (Table 4.4, 4.5 and 4.6) revealed that nitrogen levels have significant effect on number of pods plant$^{-1}$ of okra in all picking. Increase in level of nitrogen there was significantly increased the number of pods plant$^{-1}$ in all picking. The data presented in Table 4.6 further revealed that significantly higher number of pods plant$^{-1}$ (42.25) was noted with the highest levels of nitrogen N$_4$ (150 kg N ha$^{-1}$) which was found at par with application of 125 kg N ha$^{-1}$. The lowest number of pod plant$^{-1}$ (22.75) counted under the treatment N$_1$ (75 kg N ha$^{-1}$).

4.3.1.2 Effect of potash levels

The application of different levels of potash had significant effect on number of pod plant$^{-1}$ of okra in all picking (Table 4.4, 4.5 and 4.6). The data presented in Table 4.6 revealed that maximum number of pod plant$^{-1}$ (36.81) was observed under the treatment K$_5$ (37.5 kg K$_2$O ha$^{-1}$ at basal + 37.5 kg K$_2$O ha$^{-1}$ at 45 DAS) which was statistically at par with the treatment K$_4$ (25 kg
K₂O ha⁻¹ at basal + 25 kg K₂O ha⁻¹ at 45 DAS) and treatment K₃ (75 kg K₂O ha⁻¹). The minimum number of pod plant⁻¹ observed in treatment K₁ (25 kg K₂O ha⁻¹) and K₂ (50 kg K₂O ha⁻¹).

Table 4.4: Number of pod plant⁻¹ of okra recorded at various picking as influenced by different levels of nitrogen and potash

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Number of pod plant⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nitrogen levels (kg ha⁻¹)</strong></td>
<td>1st</td>
</tr>
<tr>
<td>Picking</td>
<td></td>
</tr>
<tr>
<td>N₁ = 75</td>
<td>0.91</td>
</tr>
<tr>
<td>N₂ = 100</td>
<td>1.13</td>
</tr>
<tr>
<td>N₃ = 125</td>
<td>1.52</td>
</tr>
<tr>
<td>N₄ = 150</td>
<td>1.60</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.03</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>0.09</td>
</tr>
<tr>
<td><strong>Potash levels (kg ha⁻¹)</strong></td>
<td></td>
</tr>
<tr>
<td>K₁ = 25</td>
<td>1.01</td>
</tr>
<tr>
<td>K₂ = 50</td>
<td>1.23</td>
</tr>
<tr>
<td>K₃ = 75</td>
<td>1.29</td>
</tr>
<tr>
<td>K₄ = 25 at basal + 25 at 45 DAS</td>
<td>1.30</td>
</tr>
<tr>
<td>K₅ = 37.5 at basal + 37.5 at 45 DAS</td>
<td>1.38</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.03</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>0.09</td>
</tr>
<tr>
<td>N×K interaction</td>
<td>NS</td>
</tr>
<tr>
<td>CV %</td>
<td>8.83</td>
</tr>
</tbody>
</table>
Table 4.5: Number of pod plant\textsuperscript{-1} of okra recorded at various picking as influenced by different levels of nitrogen and potash

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Number of pod plant\textsuperscript{-1}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9\textsuperscript{th}</td>
</tr>
<tr>
<td><strong>Nitrogen levels (kg ha\textsuperscript{-1})</strong></td>
<td></td>
</tr>
<tr>
<td>N\textsubscript{1} = 75</td>
<td>2.37</td>
</tr>
<tr>
<td>N\textsubscript{2} = 100</td>
<td>2.78</td>
</tr>
<tr>
<td>N\textsubscript{3} = 125</td>
<td>3.57</td>
</tr>
<tr>
<td>N\textsubscript{4} = 150</td>
<td>3.73</td>
</tr>
<tr>
<td>SEm\pm</td>
<td>0.07</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>0.21</td>
</tr>
<tr>
<td><strong>Potash levels (kg ha\textsuperscript{-1})</strong></td>
<td></td>
</tr>
<tr>
<td>K\textsubscript{1} = 25</td>
<td>2.87</td>
</tr>
<tr>
<td>K\textsubscript{2} = 50</td>
<td>2.90</td>
</tr>
<tr>
<td>K\textsubscript{3} = 75</td>
<td>3.20</td>
</tr>
<tr>
<td>K\textsubscript{4} = 25 at basal + 25 at 45 DAS</td>
<td>3.22</td>
</tr>
<tr>
<td>K\textsubscript{5} = 37.5 at basal + 37.5 at 45 DAS</td>
<td>3.38</td>
</tr>
<tr>
<td>SEm\pm</td>
<td>0.08</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>0.24</td>
</tr>
<tr>
<td><strong>N×K interaction</strong></td>
<td>NS</td>
</tr>
</tbody>
</table>
Table 4.6: Number of pod plant\(^{-1}\) as influenced by different levels of nitrogen and potash (total of all picking)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Number of pod plant(^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nitrogen levels (kg ha(^{-1}))</strong></td>
<td></td>
</tr>
<tr>
<td>(N_1 = 75)</td>
<td>22.75</td>
</tr>
<tr>
<td>(N_2 = 100)</td>
<td>29.00</td>
</tr>
<tr>
<td>(N_3 = 125)</td>
<td>40.66</td>
</tr>
<tr>
<td>(N_4 = 150)</td>
<td>42.25</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.77</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>2.21</td>
</tr>
<tr>
<td><strong>Potash levels (kg ha(^{-1}))</strong></td>
<td></td>
</tr>
<tr>
<td>(K_1 = 25)</td>
<td>29.58</td>
</tr>
<tr>
<td>(K_2 = 50)</td>
<td>30.83</td>
</tr>
<tr>
<td>(K_3 = 75)</td>
<td>34.71</td>
</tr>
<tr>
<td>(K_4 = 25)at basal + 25 at 45 DAS</td>
<td>36.39</td>
</tr>
<tr>
<td>(K_5 = 37.5)at basal + 37.5 at 45 DAS</td>
<td>36.81</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.86</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>2.47</td>
</tr>
<tr>
<td><strong>N×K interaction</strong></td>
<td>Sig.</td>
</tr>
<tr>
<td><strong>CV %</strong></td>
<td>9.87</td>
</tr>
</tbody>
</table>

**4.3.1.3 Interaction effect**

Data presented in Table 4.6 showed that interaction effect of different levels of nitrogen and potash with respect to number of pods plant\(^{-1}\) was found to be significant. Data presented in Table 4.7 showed that application
Figure 4.2: Number of pod plant$^{-1}$ as influenced by different levels of nitrogen
of 150 kg N ha\(^{-1}\) and 37.5 kg K\(_2\)O ha\(^{-1}\) at basal + 37.5 kg K\(_2\)O ha\(^{-1}\) at 45 DAS (N\(_4\)K\(_5\)) treatment combination registered significantly higher number of pods plant\(^{-1}\) (46.94). However, it was at par with treatment combination N\(_4\)K\(_4\), N\(_4\)K\(_3\), N\(_3\)K\(_5\), N\(_3\)K\(_4\) and N\(_3\)K\(_3\). While the minimum number of pods plant\(^{-1}\) was recorded under treatment combination N\(_1\)K\(_1\) (20.62).

**Table 4.7: Number of pod plant\(^{-1}\) as influenced by N×K interaction**

<table>
<thead>
<tr>
<th>Nitrogen levels (kg ha(^{-1}))</th>
<th>Number of pod plant(^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potash levels (kg ha(^{-1}))</td>
<td>K(_1)</td>
</tr>
<tr>
<td>N(_1)</td>
<td>20.62</td>
</tr>
<tr>
<td>N(_2)</td>
<td>27.83</td>
</tr>
<tr>
<td>N(_3)</td>
<td>33.06</td>
</tr>
<tr>
<td>N(_4)</td>
<td>36.80</td>
</tr>
<tr>
<td>SEm±</td>
<td>1.72</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>4.94</td>
</tr>
<tr>
<td>CV %</td>
<td>9.87</td>
</tr>
</tbody>
</table>

**4.3.2 Pod length (cm)**

Pod length as influenced by different levels of nitrogen and potash is furnished in (Table 4.8, 4.9 and 4.10) and graphically illustrated in Fig. 4.3.

**4.3.2.1 Effect of nitrogen levels**

A perusal of data (Table 4.8, 4.9 and 4.10) revealed that pod length of okra in all picking was significantly influenced due to the nitrogen levels, wherein, significantly longer pod (11.40 cm) was noted under treatment N\(_4\)
(150 kg N ha\(^{-1}\)) as compared to N\(_1\) (75 kg N ha\(^{-1}\)). However, it was at par with N\(_3\) (125 kg N ha\(^{-1}\)) (Table 4.10).

**Table 4.8:** Pod length of okra recorded at various picking as influenced by different levels of nitrogen and potash

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Pod length (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nitrogen levels (kg ha(^{-1}))</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Picking</strong></td>
<td>1(^{st})</td>
</tr>
<tr>
<td>N(_1) = 75</td>
<td>8.27</td>
</tr>
<tr>
<td>N(_3) = 125</td>
<td>9.75</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.18</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>0.54</td>
</tr>
<tr>
<td><strong>Potash levels (kg ha(^{-1}))</strong></td>
<td></td>
</tr>
<tr>
<td>K(_4) = 25 at basal + 25 at 45 DAS</td>
<td>9.56</td>
</tr>
<tr>
<td>K(_5) = 37.5 at basal + 37.5 at 45 DAS</td>
<td>9.80</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.21</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>0.60</td>
</tr>
<tr>
<td>N×K interaction</td>
<td>NS</td>
</tr>
<tr>
<td>C.V. %</td>
<td>7.72</td>
</tr>
</tbody>
</table>
Table 4.9: Pod length of okra recorded at various picking as influenced by different levels of nitrogen and potash

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Pod length (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nitrogen levels (kg ha⁻¹)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Picking</strong></td>
<td>9th</td>
</tr>
<tr>
<td>N₁ = 75</td>
<td>8.25</td>
</tr>
<tr>
<td>N₂ = 100</td>
<td>9.82</td>
</tr>
<tr>
<td>N₃ = 125</td>
<td>11.56</td>
</tr>
<tr>
<td>N₄ = 150</td>
<td>12.08</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.21</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>0.60</td>
</tr>
<tr>
<td><strong>Potash levels (kg ha⁻¹)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>K₁ = 25</strong></td>
<td>9.87</td>
</tr>
<tr>
<td><strong>K₂ = 50</strong></td>
<td>10.11</td>
</tr>
<tr>
<td><strong>K₃ = 75</strong></td>
<td>10.55</td>
</tr>
<tr>
<td><strong>K₅ = 37.5 at basal + 37.5 at 45 DAS</strong></td>
<td>10.87</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.23</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>0.67</td>
</tr>
<tr>
<td><strong>N×K interaction</strong></td>
<td>NS</td>
</tr>
<tr>
<td><strong>CV %</strong></td>
<td>7.80</td>
</tr>
</tbody>
</table>
Table 4.10: Average pod length as influenced by different levels of nitrogen and potash

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Pod length (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nitrogen levels (kg ha⁻¹)</strong></td>
<td></td>
</tr>
<tr>
<td>N₁ = 75</td>
<td>8.30</td>
</tr>
<tr>
<td>N₂ = 100</td>
<td>9.54</td>
</tr>
<tr>
<td>N₃ = 125</td>
<td>10.88</td>
</tr>
<tr>
<td>N₄ = 150</td>
<td>11.40</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.18</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>0.53</td>
</tr>
<tr>
<td><strong>Potash levels (kg ha⁻¹)</strong></td>
<td></td>
</tr>
<tr>
<td>K₁ = 25</td>
<td>9.41</td>
</tr>
<tr>
<td>K₂ = 50</td>
<td>9.77</td>
</tr>
<tr>
<td>K₃ = 75</td>
<td>10.02</td>
</tr>
<tr>
<td>K₄ = 25 at basal + 25 at 45 DAS</td>
<td>10.23</td>
</tr>
<tr>
<td>K₅ = 37.5 at basal + 37.5 at 45 DAS</td>
<td>10.51</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.21</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>0.59</td>
</tr>
<tr>
<td><strong>N×K interaction</strong></td>
<td>NS</td>
</tr>
<tr>
<td><strong>CV %</strong></td>
<td>8.15</td>
</tr>
</tbody>
</table>

4.3.2.2 Effect of potash levels

It was observed from the data presented in Table 4.8, 4.9 and 4.10 that the differences in pod length of okra due to different levels of potash were
Figure 4.3: Average pod length as influenced by different levels of nitrogen and potash
significant in all picking. Significantly the higher length of pod (10.51 cm) was registered under the treatment K₅ (37.5 kg K₂O ha⁻¹ at basal + 37.5 kg K₂O ha⁻¹ at 45 DAS) which was found at par with the treatment K₄ (25 kg K₂O ha⁻¹ at basal + 25 kg K₂O ha⁻¹ at 45 DAS) and treatment K₃ (75 kg K₂O ha⁻¹). Treatment K₁ (25 kg K₂O ha⁻¹) registered significantly lower length of pod (9.41 cm) (Table 4.10).

4.3.2.3 Interaction effect

An interaction effect of different levels of nitrogen and potash was found non-significant (Table 4.10).

4.3.3 Pod girth (cm)

Data on pod girth as influenced by different levels of nitrogen and potash are presented in (Table 4.11, 4.12 and 4.13) graphically illustrated in Fig. 4.4.

4.3.3.1 Effect of nitrogen levels

It was observed from the data presented in (Table 4.11, 4.12 and 4.13) that the differences in pod girth due to nitrogen levels were found significant in all picking, wherein, increasing levels of nitrogen significantly increased the pod girth and significantly higher value of pod girth (4.62) was recorded under the highest level of nitrogen 150 kg N ha⁻¹ (N₄). However, it was at par with application of 125 kg N ha⁻¹ (N₃). Treatment N₁ (75 kg N ha⁻¹) registered significantly the lower girth of pod in all picking (Table 4.13).
Table 4.11: Pod girth of okra recorded at various picking as influenced by different levels of nitrogen and potash

<table>
<thead>
<tr>
<th>Treatment</th>
<th>1&lt;sup&gt;st&lt;/sup&gt;</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt;</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt;</th>
<th>4&lt;sup&gt;th&lt;/sup&gt;</th>
<th>5&lt;sup&gt;th&lt;/sup&gt;</th>
<th>6&lt;sup&gt;th&lt;/sup&gt;</th>
<th>7&lt;sup&gt;th&lt;/sup&gt;</th>
<th>8&lt;sup&gt;th&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nitrogen levels (kg ha&lt;sup&gt;-1&lt;/sup&gt;)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Picking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N&lt;sub&gt;1&lt;/sub&gt; = 75</td>
<td>3.94</td>
<td>3.98</td>
<td>4.03</td>
<td>3.91</td>
<td>4.06</td>
<td>4.31</td>
<td>4.37</td>
<td>4.41</td>
</tr>
<tr>
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<td>4.05</td>
<td>4.09</td>
<td>4.14</td>
<td>4.22</td>
<td>4.13</td>
<td>4.36</td>
<td>4.53</td>
<td>4.64</td>
</tr>
<tr>
<td>N&lt;sub&gt;3&lt;/sub&gt; = 125</td>
<td>4.25</td>
<td>4.29</td>
<td>4.35</td>
<td>4.50</td>
<td>4.37</td>
<td>4.63</td>
<td>4.74</td>
<td>4.90</td>
</tr>
<tr>
<td>N&lt;sub&gt;4&lt;/sub&gt; = 150</td>
<td>4.33</td>
<td>4.36</td>
<td>4.41</td>
<td>4.57</td>
<td>4.47</td>
<td>4.69</td>
<td>4.91</td>
<td>4.96</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.06</td>
<td>0.06</td>
<td>0.06</td>
<td>0.09</td>
<td>0.10</td>
<td>0.09</td>
<td>0.11</td>
<td>0.08</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>0.18</td>
<td>0.18</td>
<td>0.18</td>
<td>0.28</td>
<td>0.31</td>
<td>0.28</td>
<td>0.33</td>
<td>0.24</td>
</tr>
<tr>
<td><strong>Potash levels (kg ha&lt;sup&gt;-1&lt;/sup&gt;)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K&lt;sub&gt;1&lt;/sub&gt; = 25</td>
<td>3.95</td>
<td>4.0</td>
<td>4.01</td>
<td>4.02</td>
<td>3.99</td>
<td>4.31</td>
<td>4.26</td>
<td>4.43</td>
</tr>
<tr>
<td>K&lt;sub&gt;2&lt;/sub&gt; = 50</td>
<td>4.07</td>
<td>4.10</td>
<td>4.15</td>
<td>4.11</td>
<td>4.14</td>
<td>4.38</td>
<td>4.45</td>
<td>4.64</td>
</tr>
<tr>
<td>K&lt;sub&gt;3&lt;/sub&gt; = 75</td>
<td>4.16</td>
<td>4.22</td>
<td>4.23</td>
<td>4.34</td>
<td>4.26</td>
<td>4.46</td>
<td>4.65</td>
<td>4.71</td>
</tr>
<tr>
<td>K&lt;sub&gt;4&lt;/sub&gt; = 25 at basal + 25 at 45 DAS</td>
<td>4.20</td>
<td>4.25</td>
<td>4.30</td>
<td>4.38</td>
<td>4.37</td>
<td>4.57</td>
<td>4.68</td>
<td>4.79</td>
</tr>
<tr>
<td>K&lt;sub&gt;5&lt;/sub&gt; = 37.5 at basal + 37.5 at 45 DAS</td>
<td>4.28</td>
<td>4.32</td>
<td>4.39</td>
<td>4.59</td>
<td>4.51</td>
<td>4.77</td>
<td>4.94</td>
<td>4.96</td>
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<tr>
<td>SEm±</td>
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<td>0.07</td>
<td>0.07</td>
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<td>0.12</td>
<td>0.11</td>
<td>0.12</td>
<td>0.09</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>0.20</td>
<td>0.21</td>
<td>0.21</td>
<td>0.31</td>
<td>0.35</td>
<td>0.32</td>
<td>0.37</td>
<td>0.27</td>
</tr>
<tr>
<td><strong>N×K interaction</strong></td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>CV %</td>
<td>5.72</td>
<td>6.01</td>
<td>6.04</td>
<td>6.58</td>
<td>6.89</td>
<td>7.54</td>
<td>7.69</td>
<td>7.04</td>
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</table>
Table 4.12: Pod girth of okra recorded at various picking as influenced by different levels of nitrogen and potash

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Pod girth (cm)</th>
<th>9th</th>
<th>10th</th>
<th>11th</th>
<th>12th</th>
<th>13th</th>
<th>14th</th>
<th>15th</th>
<th>16th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen levels (kg ha(^{-1}))</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Picking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N(_1) = 75</td>
<td>4.48</td>
<td>4.50</td>
<td>4.31</td>
<td>4.19</td>
<td>4.03</td>
<td>3.98</td>
<td>3.96</td>
<td>3.94</td>
<td></td>
</tr>
<tr>
<td>N(_2) = 100</td>
<td>4.73</td>
<td>4.75</td>
<td>4.45</td>
<td>4.33</td>
<td>4.14</td>
<td>4.10</td>
<td>4.08</td>
<td>4.06</td>
<td></td>
</tr>
<tr>
<td>N(_3) = 125</td>
<td>5.05</td>
<td>5.03</td>
<td>4.64</td>
<td>4.52</td>
<td>4.35</td>
<td>4.30</td>
<td>4.28</td>
<td>4.27</td>
<td></td>
</tr>
<tr>
<td>N(_4) = 150</td>
<td>5.15</td>
<td>5.13</td>
<td>4.69</td>
<td>4.57</td>
<td>4.42</td>
<td>4.38</td>
<td>4.36</td>
<td>4.35</td>
<td></td>
</tr>
<tr>
<td>SEm±</td>
<td>0.07</td>
<td>0.07</td>
<td>0.07</td>
<td>0.08</td>
<td>0.07</td>
<td>0.07</td>
<td>0.07</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>0.20</td>
<td>0.20</td>
<td>0.21</td>
<td>0.22</td>
<td>0.21</td>
<td>0.13</td>
<td>0.21</td>
<td>0.21</td>
<td></td>
</tr>
<tr>
<td>Potash levels (kg ha(^{-1}))</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K(_1) = 25</td>
<td>4.42</td>
<td>4.40</td>
<td>4.22</td>
<td>4.13</td>
<td>3.97</td>
<td>3.96</td>
<td>4.91</td>
<td>3.90</td>
<td></td>
</tr>
<tr>
<td>K(_2) = 50</td>
<td>4.77</td>
<td>4.77</td>
<td>4.43</td>
<td>4.33</td>
<td>4.17</td>
<td>4.12</td>
<td>4.10</td>
<td>4.09</td>
<td></td>
</tr>
<tr>
<td>K(_3) = 75</td>
<td>4.84</td>
<td>4.87</td>
<td>4.48</td>
<td>4.38</td>
<td>4.21</td>
<td>4.17</td>
<td>4.15</td>
<td>4.13</td>
<td></td>
</tr>
<tr>
<td>K(_4) = 25 at basal + 25 at 45 DAS</td>
<td>4.94</td>
<td>4.93</td>
<td>4.59</td>
<td>4.43</td>
<td>4.32</td>
<td>4.28</td>
<td>4.26</td>
<td>4.24</td>
<td></td>
</tr>
<tr>
<td>K(_5) = 37.5 at basal + 37.5 at 45 DAS</td>
<td>5.01</td>
<td>5.01</td>
<td>4.72</td>
<td>4.62</td>
<td>4.41</td>
<td>4.36</td>
<td>4.34</td>
<td>4.32</td>
<td></td>
</tr>
<tr>
<td>SEm±</td>
<td>0.08</td>
<td>0.08</td>
<td>0.08</td>
<td>0.08</td>
<td>0.08</td>
<td>0.06</td>
<td>0.08</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>0.23</td>
<td>0.23</td>
<td>0.24</td>
<td>0.24</td>
<td>0.23</td>
<td>0.19</td>
<td>0.23</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>N(_{X})K interaction</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>CV %</td>
<td>5.63</td>
<td>5.61</td>
<td>6.43</td>
<td>6.70</td>
<td>6.70</td>
<td>6.66</td>
<td>6.69</td>
<td>6.71</td>
<td></td>
</tr>
</tbody>
</table>
Table 4.13: Average pod girth as influenced by different levels of nitrogen and potash

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Pod girth (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nitrogen levels (kg ha(^{-1}))</strong></td>
<td></td>
</tr>
<tr>
<td>N(_1) = 75</td>
<td>4.16</td>
</tr>
<tr>
<td>N(_2) = 100</td>
<td>4.30</td>
</tr>
<tr>
<td>N(_3) = 125</td>
<td>4.53</td>
</tr>
<tr>
<td>N(_4) = 150</td>
<td>4.62</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.07</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>0.21</td>
</tr>
<tr>
<td><strong>Potash levels (kg ha(^{-1}))</strong></td>
<td></td>
</tr>
<tr>
<td>K(_1) = 25</td>
<td>4.19</td>
</tr>
<tr>
<td>K(_2) = 50</td>
<td>4.31</td>
</tr>
<tr>
<td>K(_3) = 75</td>
<td>4.40</td>
</tr>
<tr>
<td>K(_4) = 25 at basal + 25 at 45 DAS</td>
<td>4.48</td>
</tr>
<tr>
<td>K(_5) = 37.5 at basal + 37.5 at 45 DAS</td>
<td>4.60</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.07</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>0.20</td>
</tr>
<tr>
<td><strong>N×K interaction</strong></td>
<td>NS</td>
</tr>
<tr>
<td>CV %</td>
<td>5.51</td>
</tr>
</tbody>
</table>

4.3.3.2 Effect of potash levels

The effect of different potash levels on girth of green pod was found significant in all picking (Table 4.11, 4.12 and 4.13). Application of different levels of potash increased the girth of green pod. The significantly higher value
Figure 4.4: Average pod girth as influenced by different levels of nitrogen and potash.
of pod girth (4.60) was recorded under the treatment K₅ (37.5 kg K₂O ha⁻¹ at basal + 37.5 kg K₂O ha⁻¹ at 45 DAS) in all picking. However, it was at par with treatment K₄ (25 kg K₂O ha⁻¹ at basal + 25 kg K₂O ha⁻¹ at 45 DAS) and treatment K₃ (75 kg K₂O ha⁻¹). The significantly lower value of girth of pod (4.19) registered under the treatment K₁ (25 kg K₂O ha⁻¹).

4.3.3.3 Interaction effect

Data furnished in (Table 4.11, 4.12 and 4.13) further indicated that pod girth (cm) of okra did not influence significantly due to interaction effect of different levels of nitrogen and potash.

4.3.4 Weight of pod plant⁻¹ (g)

Data pertaining to weight of pod plant⁻¹ of okra as influenced by different levels of nitrogen and potash are presented in (Table 4.14, 4.15 and 4.16) and graphically illustrated in Fig. 4.5.

4.3.4.1 Effect of nitrogen levels

An appraisal of data presented in Table 4.14, 4.15 and 4.16 revealed that the different levels of nitrogen had significantly influenced on weight of pod plant⁻¹ in all picking. Significantly higher weight of pod plant⁻¹ (400.49 g) was observed under the treatment N₄ (150 kg N ha⁻¹), which was statistically at par with the treatment N₃ (125 kg N ha⁻¹). The lowest weight of pod plant⁻¹ (162.44 g) was recorded under the treatment N₁ (75 kg N ha⁻¹) (Table 4.16).
Table 4.14: Weight of pod plant\(^{-1}\) of okra recorded at various picking as influenced by different levels of nitrogen and potash

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Weight of pod plant(^{-1}) (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nitrogen levels (kg ha(^{-1}))</strong></td>
<td></td>
</tr>
<tr>
<td>Picking</td>
<td>1(^{st})</td>
</tr>
<tr>
<td>N(_1) = 75</td>
<td>8.16</td>
</tr>
<tr>
<td>N(_2) = 100</td>
<td>11.88</td>
</tr>
<tr>
<td>N(_3) = 125</td>
<td>15.95</td>
</tr>
<tr>
<td>N(_4) = 150</td>
<td>16.80</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.30</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>0.86</td>
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<tr>
<td><strong>Potash levels (kg ha(^{-1}))</strong></td>
<td></td>
</tr>
<tr>
<td>K(_1) = 25</td>
<td>12.11</td>
</tr>
<tr>
<td>K(_2) = 50</td>
<td>12.61</td>
</tr>
<tr>
<td>K(_3) = 75</td>
<td>13.22</td>
</tr>
<tr>
<td>K(_4) = 25 at basal + 25 at 45 DAS</td>
<td>13.28</td>
</tr>
<tr>
<td>K(_5) = 37.5 at basal + 37.5 at 45 DAS</td>
<td>14.17</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.33</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>0.99</td>
</tr>
<tr>
<td><strong>N\times K interaction</strong></td>
<td>NS</td>
</tr>
<tr>
<td>CV %</td>
<td>8.87</td>
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</table>
Table 4.15: Weight of pod plant\(^{-1}\) of okra recorded at various picking as influenced by different levels of nitrogen and potash

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Weight of pod plant(^{-1}) (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nitrogen levels (kg ha(^{-1}))</strong></td>
<td></td>
</tr>
<tr>
<td>Picking</td>
<td>9(^{th})</td>
</tr>
<tr>
<td>(N_1 = 75)</td>
<td>21.34</td>
</tr>
<tr>
<td>(N_2 = 100)</td>
<td>29.18</td>
</tr>
<tr>
<td>(N_3 = 125)</td>
<td>37.47</td>
</tr>
<tr>
<td>(N_4 = 150)</td>
<td>39.22</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.78</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>2.24</td>
</tr>
<tr>
<td><strong>Potash levels (kg ha(^{-1}))</strong></td>
<td></td>
</tr>
<tr>
<td>(K_1 = 25)</td>
<td>29.36</td>
</tr>
<tr>
<td>(K_2 = 50)</td>
<td>29.55</td>
</tr>
<tr>
<td>(K_3 = 75)</td>
<td>32.73</td>
</tr>
<tr>
<td>(K_4 = 25) at basal + 25 at 45 DAS</td>
<td>32.87</td>
</tr>
<tr>
<td>(K_5 = 37.5) at basal + 37.5 at 45 DAS</td>
<td>34.51</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.87</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>2.51</td>
</tr>
<tr>
<td><strong>N×K interaction</strong></td>
<td>NS</td>
</tr>
</tbody>
</table>
Table 4.16: Weight of pod plant\(^{-1}\) of okra influenced by different levels of nitrogen and potash (Total of all picking)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Weight of pod plant(^{-1}) (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nitrogen levels (kg ha(^{-1}))</strong></td>
<td></td>
</tr>
<tr>
<td>N(_1) = 75</td>
<td>162.44</td>
</tr>
<tr>
<td>N(_2) = 100</td>
<td>262.99</td>
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<td>N(_3) = 125</td>
<td>380.73</td>
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<tr>
<td>N(_4) = 150</td>
<td>400.49</td>
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<tr>
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<td>8.14</td>
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<tr>
<td>CD (P=0.05)</td>
<td>23.32</td>
</tr>
<tr>
<td><strong>Potash levels (kg ha(^{-1}))</strong></td>
<td></td>
</tr>
<tr>
<td>K(_1) = 25</td>
<td>259.75</td>
</tr>
<tr>
<td>K(_2) = 50</td>
<td>273.15</td>
</tr>
<tr>
<td>K(_3) = 75</td>
<td>315.74</td>
</tr>
<tr>
<td>K(_4) = 25 at basal + 25 at 45 DAS</td>
<td>326.31</td>
</tr>
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<td>K(_5) = 37.5 at basal + 37.5 at 45 DAS</td>
<td>333.35</td>
</tr>
<tr>
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<td>9.10</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>26.07</td>
</tr>
<tr>
<td><strong>N\times K interaction</strong></td>
<td>Sig.</td>
</tr>
<tr>
<td><strong>CV %</strong></td>
<td>10.45</td>
</tr>
</tbody>
</table>

4.3.4.2 Effect of potash levels

The application of different levels of potash had significant effect on weight of pod plant\(^{-1}\) of okra in all picking (Table 4.14, 4.15 and 4.16). The significantly higher weight of pod plant\(^{-1}\) (333.35 g) was observed under the treatment K\(_5\) (37.5 kg K\(_2\)O ha\(^{-1}\) at basal + 37.5 kg K\(_2\)O ha\(^{-1}\) at 45 DAS), which
Figure 4.5: Weight of pod plant$^{-1}$ as influenced by different levels of nitrogen and potash
was statistically at par with treatment \textit{K}_4 (25 \text{ kg K}_2\text{O ha}^{-1} \text{ at basal + 25 kg K}_2\text{O ha}^{-1} \text{ at 45 DAS}), and treatment \textit{K}_3 (75 \text{ kg K}_2\text{O ha}^{-1}). Significantly lower weight of pod plant\textsuperscript{-1} (259.75 g) listed under the treatment \textit{K}_1 (25 \text{ kg K}_2\text{O ha}^{-1}) (Table 4.16).

\textbf{4.3.4.3 Interaction effect}

The interaction effect of different levels of nitrogen and potash (Table 4.17) was found significant. Significantly the higher weight of pod plant\textsuperscript{-1} (455.65 g) was found in treatment combination \textit{N}_4\textit{K}_5 (150 \text{ kg N ha}^{-1} \text{ and 37.5 kg K}_2\text{O ha}^{-1} \text{ at basal + 37.5 kg K}_2\text{O ha}^{-1} \text{ at 45 DAS}) which was being at par with treatment combination of \textit{N}_4\textit{K}_4, \textit{N}_4\textit{K}_3, \textit{N}_3\textit{K}_5, \textit{N}_3\textit{K}_4 and \textit{N}_3\textit{K}_3. Significantly lower weight of pod plant\textsuperscript{-1} (146.10 g) was observed under treatment combination \textit{N}_1\textit{K}_1 (75 \text{ kg N ha}^{-1} + 25 \text{ kg K}_2\text{O ha}^{-1}).

\textbf{Table 4.17: Weight of pod plant\textsuperscript{-1} (g) as influenced by N×K interaction}

<table>
<thead>
<tr>
<th>Nitrogen levels (kg ha\textsuperscript{-1})</th>
<th>Weight of pod plant\textsuperscript{-1} (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Potash levels (kg ha\textsuperscript{-1})</td>
</tr>
<tr>
<td></td>
<td>\textit{K}_1</td>
</tr>
<tr>
<td>\textit{N}_1</td>
<td>146.10</td>
</tr>
<tr>
<td>\textit{N}_2</td>
<td>247.33</td>
</tr>
<tr>
<td>\textit{N}_3</td>
<td>302.66</td>
</tr>
<tr>
<td>\textit{N}_4</td>
<td>342.91</td>
</tr>
<tr>
<td>SEm±</td>
<td>18.20</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>54.15</td>
</tr>
<tr>
<td>CV %</td>
<td>10.45</td>
</tr>
</tbody>
</table>
4.3.5 Green pod yield (q ha\(^{-1}\))

Data pertaining to per hectare green pod yield of okra as influenced by different levels of nitrogen and potash are presented in Table 4.18 and graphically illustrated in Fig. 4.6.

4.3.5.1 Effect of nitrogen levels

A Perusal of data given in Table 4.18 showed that nitrogen levels had significant influence on green pod yield. The pod yield was increased appreciably with each successive increase in nitrogen level up to 150 kg N ha\(^{-1}\). Significantly higher green pod yield (147.31 q ha\(^{-1}\)) was noted under the highest level of nitrogen @ 150 kg ha\(^{-1}\) (N\(_4\)) than rest of the treatment. However, it was at par with nitrogen level @ 125 kg N ha\(^{-1}\) (N\(_3\)) and recorded 144.35 q ha\(^{-1}\) green pod yield. The lowest green pod yield (73.02 q ha\(^{-1}\)) was noted under the lowest level of nitrogen @ 75 kg ha\(^{-1}\) (N\(_1\)).

4.3.5.2 Effect of potash levels

An appraisal of data (Table 4.18) revealed that the differences in green pod yield due to different levels of potash were found significant. Significantly the higher green pod yield of okra (132.59 q ha\(^{-1}\)) was registered under the treatment K\(_5\) (37.5 kg K\(_2\)O ha\(^{-1}\) at basal + 37.5 kg K\(_2\)O ha\(^{-1}\) at 45 DAS). However, it was at par with treatment K\(_4\) (25 kg K\(_2\)O ha\(^{-1}\) at basal + 25 kg K\(_2\)O ha\(^{-1}\) at 45 DAS) and treatment K\(_3\) (75 kg K\(_2\)O ha\(^{-1}\)). Treatment K\(_1\) registered significantly the lower green pod yield (101.54 q ha\(^{-1}\)). Treatment K\(_2\), K\(_3\) and K\(_4\) recorded green pod yield of 108.83, 125.79 and 130.60 q ha\(^{-1}\), respectively.
Table 4.18: Green pod yield as influenced by different levels of nitrogen and potash

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Green pod yield (q ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nitrogen levels (kg ha(^{-1}))</strong></td>
<td></td>
</tr>
<tr>
<td>N(_1) = 75</td>
<td>73.02</td>
</tr>
<tr>
<td>N(_2) = 100</td>
<td>114.80</td>
</tr>
<tr>
<td>N(_3) = 125</td>
<td>144.35</td>
</tr>
<tr>
<td>N(_4) = 150</td>
<td>147.31</td>
</tr>
<tr>
<td>SEm±</td>
<td>3.41</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>9.77</td>
</tr>
<tr>
<td><strong>Potash levels (kg ha(^{-1}))</strong></td>
<td></td>
</tr>
<tr>
<td>K(_1) = 25</td>
<td>101.54</td>
</tr>
<tr>
<td>K(_2) = 50</td>
<td>108.83</td>
</tr>
<tr>
<td>K(_3) = 75</td>
<td>125.79</td>
</tr>
<tr>
<td>K(_4) = 25 at basal + 25 at 45 DAS</td>
<td>130.60</td>
</tr>
<tr>
<td>K(_5) = 37.5 at basal + 37.5 at 45 DAS</td>
<td>132.59</td>
</tr>
<tr>
<td>SEm±</td>
<td>3.82</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>10.92</td>
</tr>
<tr>
<td><strong>N×K interaction</strong></td>
<td>Sig.</td>
</tr>
<tr>
<td><strong>CV %</strong></td>
<td>11.02</td>
</tr>
</tbody>
</table>

4.3.5.3 Interaction effect

The interaction effect of different levels of nitrogen and potash was found significant with respect to green pod yield (Table 4.18). Data on N × K interaction (Table 4.19) indicated that treatment combination of N\(_4\)K\(_5\) (150 kg
Figure 4.6: Green pod yield as influenced by different levels of nitrogen and potash
N ha\(^{-1}\) and 37.5 kg K\(_2\)O ha\(^{-1}\) at basal + 37.5 kg K\(_2\)O ha\(^{-1}\) at 45 DAS) produced significantly higher green pod yield (167.45 q ha\(^{-1}\)) than rest of the treatment combinations except N\(_4\)K\(_4\), N\(_4\)K\(_3\), N\(_3\)K\(_5\), N\(_3\)K\(_4\) and N\(_3\)K\(_3\). Significantly lower green pod yield (65.82 q ha\(^{-1}\)) was recorded under the treatment combination N\(_1\)K\(_1\) than other treatment combinations.

**Table 4.19: Green pod yield (q ha\(^{-1}\)) as influenced by N\(\times\)K interaction**

<table>
<thead>
<tr>
<th>Nitrogen levels (kg ha(^{-1}))</th>
<th>Green pod yield (q ha(^{-1}))</th>
<th>Potash levels (kg ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>K(_1)</td>
</tr>
<tr>
<td>N(_1)</td>
<td>65.82</td>
<td>71.01</td>
</tr>
<tr>
<td>N(_2)</td>
<td>108.50</td>
<td>114.27</td>
</tr>
<tr>
<td>N(_3)</td>
<td>114.71</td>
<td>123.93</td>
</tr>
<tr>
<td>N(_4)</td>
<td>117.131</td>
<td>126.08</td>
</tr>
</tbody>
</table>

SEm\(\pm\) 7.63
CD (P=0.05) 21.84
CV % 11.02

**4.4 EFFECT OF TREATMENTS ON QUALITY PARAMETERS**

**4.4.1 Moisture (%)**

The mean values of moisture percentage as influenced by different levels of nitrogen and potash are illustrated in the Table 4.20.

**4.4.1.1 Effect of nitrogen levels**

Analysis of data (Table 4.20) showed that different levels of nitrogen did not exert their significant influence on the moisture percentage.
4.4.1.2 Effect of potash levels

The effect of different levels of potash on moisture percentage was found non-significant (Table 4.20).

4.4.1.3 Interaction effect

Interaction effect of nitrogen and potash was found non-significant with respect to moisture content of okra fruit (Table 4.20).

4.4.2 Total chlorophyll content \((\text{mg g}^{-1})\)

The mean values chlorophyll content \((\text{mg g}^{-1})\) as influenced by different levels of nitrogen and potash are illustrated in the Table 4.20.

4.4.2.1 Effect of nitrogen levels

Data indicated that there was significantly increase in total chlorophyll content with the increasing level of nitrogen (Table 4.20). Significantly higher chlorophyll content \((1.67 \text{ mg g}^{-1})\) was obtained under the treatment \(N_4\) \((150 \text{ kg N ha}^{-1})\), which was at par with treatment \(N_3\) \((125 \text{ kg N ha}^{-1})\). The lowest total chlorophyll content \((1.29 \text{ mg g}^{-1})\) was noted under the treatment \(N_1\) \((75 \text{ kg N ha}^{-1})\).

4.4.2.2 Effect of potash levels

An appraisal of mean data pertaining to the influence of different levels of potash on the total chlorophyll content indicated that there was significant difference (Table 4.20) in total chlorophyll content. Significantly higher total chlorophyll content \((1.59 \text{ mg g}^{-1})\) was recorded in the treatment \(K_5\) \((37.5 \text{ kg K}_2\text{O ha}^{-1} \text{ at basal} + 37.5 \text{ kg K}_2\text{O ha}^{-1} \text{ at 45 DAS})\). However, it was at par with treatment \(K_4\) \((25 \text{ kg K}_2\text{O ha}^{-1} \text{ at basal} + 25 \text{ kg K}_2\text{O ha}^{-1} \text{ at 45 DAS})\), and
treatment K₃ (75 kg K₂O ha⁻¹). The lowest total chlorophyll content of okra fruit (1.37 mg g⁻¹) was found under the treatment K₁ (25 kg K₂O ha⁻¹).

4.4.2.3 Interaction effect

Data given in Table 4.20 further revealed that total chlorophyll content in plant was found non-significant due to different levels of nitrogen and potash interaction.

4.4.3 Mucilage content (mg g⁻¹)

The mean values of mucilage content as influenced by different levels of nitrogen and potash are illustrated in the Table 4.20.

4.4.3.1 Effect of nitrogen levels

The effect of different levels of nitrogen on mucilage content of okra fruit was found non-significant (Table 4.20).

4.4.3.2 Effect of potash levels

The effect of different levels of potash on mucilage content of okra fruit was found significant (Table 4.20). Significantly the higher mucilage content (242.64 mg g⁻¹) was obtained under the treatment K₅ (37.5 kg K₂O ha⁻¹ at basal + 37.5 kg K₂O ha⁻¹ at 45 DAS). However, it was at par with treatment K₄ (25 kg K₂O ha⁻¹ at basal + 25 kg K₂O ha⁻¹ at 45 DAS), and treatment K₃ (75 kg K₂O ha⁻¹). Significantly lower mucilage content of okra fruit (227.62 mg g⁻¹) was found under the treatment K₁ (25 kg K₂O ha⁻¹).

4.4.2.3 Interaction effect

Data given in Table 4.20 further revealed that mucilage content in okra fruit was found non-significant due to nitrogen and potash interaction.
Table 4.20: Quality parameter as influenced by nitrogen and potash levels

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Moisture (%)</th>
<th>Total chlorophyll content (mg g⁻¹)</th>
<th>Mucilage (mg g⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nitrogen levels (kg ha⁻¹)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N₁ = 75</td>
<td>80.07</td>
<td>1.29</td>
<td>232.76</td>
</tr>
<tr>
<td>N₂ = 100</td>
<td>80.59</td>
<td>1.44</td>
<td>233.65</td>
</tr>
<tr>
<td>N₃ = 125</td>
<td>81.17</td>
<td>1.61</td>
<td>235.68</td>
</tr>
<tr>
<td>N₄ = 150</td>
<td>82.07</td>
<td>1.67</td>
<td>236.16</td>
</tr>
<tr>
<td>S.Em±</td>
<td>0.84</td>
<td>0.02</td>
<td>2.28</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>NS</td>
<td>0.06</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Potash levels (kg ha⁻¹)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K₁ = 25</td>
<td>79.69</td>
<td>1.37</td>
<td>227.62</td>
</tr>
<tr>
<td>K₂ = 50</td>
<td>80.35</td>
<td>1.47</td>
<td>229.34</td>
</tr>
<tr>
<td>K₃ = 75</td>
<td>81.20</td>
<td>1.53</td>
<td>236.01</td>
</tr>
<tr>
<td>K₄ = 25 at basal + 25 at 45 DAS</td>
<td>81.70</td>
<td>1.54</td>
<td>237.20</td>
</tr>
<tr>
<td>K₅ = 37.5 at basal + 37.5 at 45 DAS</td>
<td>81.93</td>
<td>1.59</td>
<td>242.64</td>
</tr>
<tr>
<td>S.Em±</td>
<td>0.95</td>
<td>0.02</td>
<td>2.55</td>
</tr>
<tr>
<td>C.D. (P=0.05)</td>
<td>NS</td>
<td>0.07</td>
<td>7.30</td>
</tr>
<tr>
<td><strong>N×K interaction</strong></td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>CV %</td>
<td>4.06</td>
<td>5.54</td>
<td>3.76</td>
</tr>
</tbody>
</table>
4.5 EFFECT OF TREATMENTS ON CHEMICAL PARAMETERS

4.5.1 Organic carbon

The data on organic carbon in soil after harvest of the crop as influenced by different levels of nitrogen and potash are presented in Table 4.21.

4.5.1.1 Effect of nitrogen levels

The difference in organic carbon status in soil after harvest of the crop due to different levels of nitrogen was remained non-significant (Table 4.21). Numerically higher organic carbon (0.47 %) in soil was recorded under treatment N₄ (150 kg N ha⁻¹) than treatment N₁ (75 kg N ha⁻¹), N₂ (100 kg N ha⁻¹) and N₃ (125 kg N ha⁻¹).

4.5.1.2 Effect of potash levels

Data presented in Table 4.21 indicated that the effect of different levels of potash on organic carbon status in soil after harvest of the crop was non-significant.

4.5.1.3 Interaction effect

Interaction effect of different levels of nitrogen and potash was non-significant (Table 4.21) with respect to organic carbon in soil after harvest of the crop.

4.5.2 Available nitrogen

The data on available nitrogen in soil after harvest of the crop as influenced by different levels of nitrogen and potash are presented in Table 4.21.
4.5.2.1 Effect of nitrogen levels

The effect of different levels of nitrogen with respect to N status of soil after harvest of the crop was found significant (Table 4.21). Significantly higher N (275.96 kg ha\(^{-1}\)) status of soil after harvest was recorded under the treatment N\(_4\) (150 kg N ha\(^{-1}\)). However, it was at par with treatment N\(_3\) (125 kg N ha\(^{-1}\)). Significantly the lowest N (238.11 kg ha\(^{-1}\)) status of soil after harvest was recorded under the treatment N\(_1\) (75 kg N ha\(^{-1}\)).

4.5.2.2 Effect of potash levels

It is clear from the data (Table 4.21) that the different levels of potash did not manifest its significant effect on available nitrogen in soil after harvest of the crop.

4.5.2.3 Interaction effect

Interaction effect of different levels of nitrogen and potash was non-significant in respect to available nitrogen in soil after harvest of the crop (Table 4.21).

4.5.3 Available phosphorus

The data on available phosphorus in soil after harvest of the crop as influenced by different levels of nitrogen and potash are presented in Table 4.21.

4.5.3.1 Effect of nitrogen levels

Data contemplated in Table 4.21 indicated that different nitrogen levels failed to exhibit its significant variation on available phosphorus in soil after harvest of the crop.
Table 4.21: Organic carbon, available nitrogen, available phosphorus and available potassium of soil after harvesting of crop as influenced by different levels of nitrogen and potash

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Organic carbon (%)</th>
<th>Available nitrogen (kg ha⁻¹)</th>
<th>Available phosphorus (kg ha⁻¹)</th>
<th>Available potassium (kg ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nitrogen levels (kg ha⁻¹)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N₁ = 75</td>
<td>0.46</td>
<td>238.11</td>
<td>42.15</td>
<td>240.41</td>
</tr>
<tr>
<td>N₂ = 100</td>
<td>0.46</td>
<td>256.00</td>
<td>43.93</td>
<td>240.74</td>
</tr>
<tr>
<td>N₃ = 125</td>
<td>0.47</td>
<td>270.08</td>
<td>46.57</td>
<td>246.03</td>
</tr>
<tr>
<td>N₄ = 150</td>
<td>0.47</td>
<td>275.96</td>
<td>46.69</td>
<td>250.45</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.01</td>
<td>6.13</td>
<td>1.58</td>
<td>3.44</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>NS</td>
<td>17.55</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Potash levels (kg ha⁻¹)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K₁ = 25</td>
<td>0.45</td>
<td>254.46</td>
<td>43.15</td>
<td>232.15</td>
</tr>
<tr>
<td>K₂ = 50</td>
<td>0.46</td>
<td>256.62</td>
<td>43.93</td>
<td>238.15</td>
</tr>
<tr>
<td>K₃ = 75</td>
<td>0.47</td>
<td>261.78</td>
<td>45.10</td>
<td>243.09</td>
</tr>
<tr>
<td>K₄ = 25 at basal + 25 at 45 DAS</td>
<td>0.46</td>
<td>257.77</td>
<td>44.50</td>
<td>242.19</td>
</tr>
<tr>
<td>K₅ = 37.5 at basal +37.5 at 45 DAS</td>
<td>0.47</td>
<td>269.56</td>
<td>46.26</td>
<td>260.20</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.01</td>
<td>6.85</td>
<td>1.76</td>
<td>3.84</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>11.00</td>
</tr>
<tr>
<td><strong>N×K interaction</strong></td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td><strong>CV %</strong></td>
<td>8.66</td>
<td>9.13</td>
<td>13.67</td>
<td>5.45</td>
</tr>
</tbody>
</table>
4.5.3.2 Effect of potash levels

It is clear from the data (Table 4.21) that the different levels of potash did not manifest its significant effect on available phosphorus in soil after harvest of the crop.

4.5.3.3 Interaction effect

Interaction effect of different levels of nitrogen and potash was non-significant in respect to available phosphorus in soil after harvest of the crop in Table 4.21.

4.5.4 Available potassium

Data regarding to available potassium in soil after harvest of the crop as influenced by different levels of nitrogen and potash are presented in Table 4.21.

4.5.4.1 Effect of nitrogen levels

Data furnished in Table 4.21 indicated that available potassium in soil was failed to reach at level of significant due to different nitrogen levels.

4.5.4.2 Effect of potash levels

The influence of different levels of potash with respect to K$_2$O status of soil after the harvest of crop was found significant (Table 4.21). Significantly highest K$_2$O status of soil (260.20 kg ha$^{-1}$) after harvest was recorded under the treatment K$_5$ (37.5 kg K$_2$O ha$^{-1}$ at basal + 37.5 kg K$_2$O ha$^{-1}$ at 45 DAS). Significantly the lower K$_2$O status of soil after harvest (232.15 kg ha$^{-1}$) was recorded under the treatment K$_1$ (25 kg K$_2$O ha$^{-1}$).
4.5.4.3 Interaction effect

Interaction effect of different levels of nitrogen and potash was non-significant in respect to available potassium in soil after harvest of the crop (Table 4.21).

4.5.5 Nitrogen content in plant (%)

Nitrogen content in plant of okra as influenced by different levels of nitrogen and potash is presented in Table 4.22.

4.5.5.1 Effect of nitrogen levels

It is evident from the results given in Table 4.22 that nitrogen content in plant was significantly influenced due to nitrogen levels. In general, increasing rate of nitrogen from N₁ (75 kg N ha⁻¹) to N₄ (150 kg N ha⁻¹) tended to increase nitrogen content by plant and significantly the higher nitrogen content (1.52 %) by plant of okra was observed under 150 kg N ha⁻¹ (N₄), which was remained at par with treatment N₃ (125 kg N ha⁻¹). The lowest N content in plant (1.05%) was observed under the treatment N₁ (75 kg N ha⁻¹).

4.5.5.2 Effect of potash levels

A perusal of data (Table 4.22) revealed that nitrogen content in plant was non-significant due to the different levels of potash.

4.5.5.3 Interaction effect

The result presented in Table 4.22 revealed that nitrogen content in plant was found non-significant influenced due to nitrogen and potash interaction.
4.5.6 Phosphorus content in plant (%) 

Phosphorus content in plant as influenced by different levels of nitrogen and potash is presented in Table 4.22.

4.5.6.1 Effect of nitrogen levels 

It is clear from the data (Table 4.22) that the different levels of nitrogen did not manifest its significant effect on phosphorus content in plant.

4.5.6.2 Effect of potash levels 

An appraisal of data given in Table 4.22 indicated that phosphorus content in plant was non-significant influenced due to different levels of potash.

4.5.6.3 Interaction effect 

Data given in Table 4.22 further revealed that phosphorus content in plant was found not significant due to N×K interaction.

4.5.7 Potash content in plant (%) 

Potash content in plant as influenced by different levels of nitrogen and potash is furnished in Table 4.22.

4.5.7.1 Effect of nitrogen levels 

Data pertaining to potash content in plant given in Table 4.22 showed that differences in potash content in plant due to nitrogen levels were found non-significant.

4.5.7.2 Effect of potash levels 

The influence of different levels of potash on K content in plant was found significant (Table 4.22). Significantly higher K content (1.59%) was
observed under the treatment K₅ (37.5 kg K₂O ha⁻¹ at basal + 37.5 kg K₂O ha⁻¹ at 45 DAS). Significantly Lower K content (1.23%) was recorded under the treatment K₁ (25 kg K₂O ha⁻¹).

Table 4.22: N, P and K plant content as influenced by nitrogen and potash levels

<table>
<thead>
<tr>
<th>Treatments</th>
<th>N content (%)</th>
<th>P content (%)</th>
<th>K content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nitrogen levels (kg ha⁻¹)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N₁ = 75</td>
<td>1.05</td>
<td>0.49</td>
<td>1.35</td>
</tr>
<tr>
<td>N₂ = 100</td>
<td>1.18</td>
<td>0.50</td>
<td>1.38</td>
</tr>
<tr>
<td>N₃ = 125</td>
<td>1.42</td>
<td>0.51</td>
<td>1.45</td>
</tr>
<tr>
<td>N₄ = 150</td>
<td>1.52</td>
<td>0.51</td>
<td>1.49</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.03</td>
<td>0.01</td>
<td>0.05</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>0.11</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Potash levels (kg ha⁻¹)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K₁ = 25</td>
<td>1.22</td>
<td>0.48</td>
<td>1.23</td>
</tr>
<tr>
<td>K₂ = 50</td>
<td>1.27</td>
<td>0.50</td>
<td>1.32</td>
</tr>
<tr>
<td>K₃ = 75</td>
<td>1.32</td>
<td>0.51</td>
<td>1.46</td>
</tr>
<tr>
<td>K₄ = 25 at basal + 25 at 45 DAS</td>
<td>1.30</td>
<td>0.50</td>
<td>1.48</td>
</tr>
<tr>
<td>K₅ = 37.5 at basal + 37.5 at 45 DAS</td>
<td>1.34</td>
<td>0.52</td>
<td>1.59</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.04</td>
<td>0.008</td>
<td>0.04</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>NS</td>
<td>NS</td>
<td>0.14</td>
</tr>
<tr>
<td><strong>N×K interaction</strong></td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>CV %</td>
<td>5.53</td>
<td>5.85</td>
<td>5.54</td>
</tr>
</tbody>
</table>
4.5.7.3 Interaction effect

Potash content in plant due to interaction effect of different levels of nitrogen and potash was found non-significant.

4.6 Effect of treatments on economics

Economics as influenced by different levels of nitrogen and potash and their interaction effects are presented in Table 4.23 and 4.24.

4.6.1 Effect of nitrogen levels

An appraisal data presented in Table 4.23 revealed that application of 150 kg N ha$^{-1}$ ($N_4$) accrued maximum net profit ($\mathcal{R} 232731$ ha$^{-1}$) with BCR value of 3.76 while, application of 125 kg N ha$^{-1}$ ($N_3$) recorded $\mathcal{R} 227137$ ha$^{-1}$ net profit with the BCR of 3.64. The lowest net realization $\mathcal{R} 85130$ ha$^{-1}$ was noticed under application of 75 kg N ha$^{-1}$ ($N_1$) with 1.39 BCR value.

4.6.2 Effect of potash levels

The results given in Table 4.23 regarding economics as influenced by potash levels indicated that application of $K_5$ (37.5 kg $K_2O$ ha$^{-1}$ at basal + 37.5 kg $K_2O$ ha$^{-1}$ at 45 DAS) recorded the highest net realization ($\mathcal{R} 203149$ ha$^{-1}$) with maximum BCR value of 3.27. The next best treatment was $K_4$ (25 kg $K_2O$ ha$^{-1}$ at basal + 25 kg $K_2O$ ha$^{-1}$ at 45 DAS) which registered $\mathcal{R} 199915$ ha$^{-1}$ net realization with the BCR value of 3.25. Treatment $K_1$ (25 kg $K_2O$ ha$^{-1}$) occupied lowest position by recording the net realization of $\mathcal{R} 142442$ ha$^{-1}$ with the BCR of 2.35.
4.6.3 Interaction effect

Economics of different treatment combinations are presented in Table 4.24 revealed that maximum net profit was recorded under the treatment combination $N_4K_5$ (₹ 270772 ha$^{-1}$ with 4.22 BCR value) followed by treatment combination $N_4K_4$ (₹ 267369 ha$^{-1}$ with 4.21 BCR value), $N_3K_4$ (₹ 267195 ha$^{-1}$ with 4.23 BCR value). The lowest net realization of ₹ 69885 ha$^{-1}$ with 1.13 BCR value was recorded under the treatment combination $N_1K_1$. 
### Table 4.23: Economics as influenced by different levels of nitrogen and potash levels

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Green pod yield (q ha(^{-1}))</th>
<th>Cost of treatment (₹ ha(^{-1}))</th>
<th>Common cost (₹ ha(^{-1}))</th>
<th>Total cost (₹ ha(^{-1}))</th>
<th>Gross realization (₹ ha(^{-1}))</th>
<th>Net realization (₹ ha(^{-1}))</th>
<th>BCR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nitrogen levels (kg ha(^{-1}))</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N(_1) = 75</td>
<td>73</td>
<td>1128</td>
<td>59783</td>
<td>60911</td>
<td>146041</td>
<td>85130</td>
<td>1.39</td>
</tr>
<tr>
<td>N(_2) = 100</td>
<td>115</td>
<td>1454</td>
<td>59783</td>
<td>61237</td>
<td>229606</td>
<td>168369</td>
<td>2.75</td>
</tr>
<tr>
<td>N(_3) = 125</td>
<td>144</td>
<td>1780</td>
<td>59783</td>
<td>61563</td>
<td>288700</td>
<td>227137</td>
<td>3.69</td>
</tr>
<tr>
<td>N(_4) = 150</td>
<td>147</td>
<td>2106</td>
<td>59783</td>
<td>61889</td>
<td>294620</td>
<td>232731</td>
<td>3.76</td>
</tr>
<tr>
<td><strong>Potash levels (kg ha(^{-1}))</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K(_1) = 25</td>
<td>102</td>
<td>855</td>
<td>59783</td>
<td>60638</td>
<td>203080</td>
<td>142442</td>
<td>2.34</td>
</tr>
<tr>
<td>K(_2) = 50</td>
<td>109</td>
<td>1542</td>
<td>59783</td>
<td>61325</td>
<td>217660</td>
<td>156335</td>
<td>2.54</td>
</tr>
<tr>
<td>K(_3) = 75</td>
<td>126</td>
<td>2248</td>
<td>59783</td>
<td>62031</td>
<td>251580</td>
<td>189549</td>
<td>3.05</td>
</tr>
<tr>
<td>K(_4) = 25 at basal + 25 at 45 DAS</td>
<td>131</td>
<td>1542</td>
<td>59783</td>
<td>61325</td>
<td>261240</td>
<td>199915</td>
<td>3.25</td>
</tr>
<tr>
<td>K(_5) = 37.5 at basal + 37.5 at 45 DAS</td>
<td>133</td>
<td>2248</td>
<td>59783</td>
<td>62031</td>
<td>265180</td>
<td>203149</td>
<td>3.27</td>
</tr>
</tbody>
</table>

**Input cost**
Urea @ ₹ 6.0 kg\(^{-1}\)

**Selling price**
Okra fruit @ ₹ 20 kg\(^{-1}\)
Table 4.24: Economics of different treatment combinations

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Treatment</th>
<th>Green pod yield (q ha⁻¹)</th>
<th>Cost of cultivation (₹ ha⁻¹)</th>
<th>Gross realization (₹ ha⁻¹)</th>
<th>Net realization (₹ ha⁻¹)</th>
<th>BCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N₁K₁</td>
<td>66</td>
<td>61766</td>
<td>131652</td>
<td>69886</td>
<td>1.13</td>
</tr>
<tr>
<td>2</td>
<td>N₁K₂</td>
<td>71</td>
<td>62453</td>
<td>142035</td>
<td>79582</td>
<td>1.27</td>
</tr>
<tr>
<td>3</td>
<td>N₁K₃</td>
<td>75</td>
<td>63159</td>
<td>150095</td>
<td>86936</td>
<td>1.38</td>
</tr>
<tr>
<td>4</td>
<td>N₁K₄</td>
<td>74</td>
<td>62453</td>
<td>148897</td>
<td>86444</td>
<td>1.38</td>
</tr>
<tr>
<td>5</td>
<td>N₁K₅</td>
<td>79</td>
<td>63159</td>
<td>157528</td>
<td>94369</td>
<td>1.49</td>
</tr>
<tr>
<td>6</td>
<td>N₂K₁</td>
<td>109</td>
<td>62092</td>
<td>217010</td>
<td>154918</td>
<td>2.49</td>
</tr>
<tr>
<td>7</td>
<td>N₂K₂</td>
<td>114</td>
<td>62779</td>
<td>228556</td>
<td>165777</td>
<td>2.64</td>
</tr>
<tr>
<td>8</td>
<td>N₂K₃</td>
<td>115</td>
<td>63485</td>
<td>230028</td>
<td>166544</td>
<td>2.62</td>
</tr>
<tr>
<td>9</td>
<td>N₂K₄</td>
<td>117</td>
<td>62779</td>
<td>234839</td>
<td>172061</td>
<td>2.74</td>
</tr>
<tr>
<td>10</td>
<td>N₂K₅</td>
<td>119</td>
<td>63485</td>
<td>237593</td>
<td>1741078</td>
<td>2.74</td>
</tr>
<tr>
<td>11</td>
<td>N₃K₁</td>
<td>115</td>
<td>62418</td>
<td>229420</td>
<td>167002</td>
<td>2.68</td>
</tr>
<tr>
<td>12</td>
<td>N₃K₂</td>
<td>124</td>
<td>63105</td>
<td>247877</td>
<td>184772</td>
<td>2.93</td>
</tr>
<tr>
<td>13</td>
<td>N₃K₃</td>
<td>153</td>
<td>63811</td>
<td>305186</td>
<td>241375</td>
<td>3.78</td>
</tr>
<tr>
<td>14</td>
<td>N₃K₄</td>
<td>165</td>
<td>63105</td>
<td>330300</td>
<td>267195</td>
<td>4.23</td>
</tr>
<tr>
<td>15</td>
<td>N₃K₅</td>
<td>165</td>
<td>63811</td>
<td>330700</td>
<td>266889</td>
<td>4.18</td>
</tr>
<tr>
<td>16</td>
<td>N₄K₁</td>
<td>117</td>
<td>62744</td>
<td>234260</td>
<td>171516</td>
<td>2.73</td>
</tr>
<tr>
<td>17</td>
<td>N₄K₂</td>
<td>126</td>
<td>63431</td>
<td>252171</td>
<td>188741</td>
<td>2.97</td>
</tr>
<tr>
<td>18</td>
<td>N₄K₃</td>
<td>161</td>
<td>64137</td>
<td>320973</td>
<td>256837</td>
<td>4.00</td>
</tr>
<tr>
<td>19</td>
<td>N₄K₄</td>
<td>165</td>
<td>63431</td>
<td>330799</td>
<td>267369</td>
<td>4.21</td>
</tr>
<tr>
<td>20</td>
<td>N₄K₅</td>
<td>167</td>
<td>64137</td>
<td>334909</td>
<td>270772</td>
<td>4.22</td>
</tr>
</tbody>
</table>
Discussion
V. DISCUSSION

The results obtained from the present investigation entitled “Effect of nitrogen and potash levels on growth and green fruit yield of okra (Abelmoschus esculentus L. Moench) during kharif season under middle Gujarat conditions” described critically with the relevant references based on experimental evidences. This chapter has been discussed under following sub-heads.

5.1 EFFECT OF WEATHER PARAMETERS ON CROP

5.2 EFFECT OF NITROGEN LEVELS

5.3 EFFECT OF POTASH LEVELS

5.4 INTERACTION EFFECT OF NITROGEN AND POTASH LEVELS

5.5 EFFECT OF TREATMENTS ON ECONOMICS

5.1 EFFECT OF WEATHER PARAMETERS ON CROP

Among different factors responsible for influencing the yield and performance of crop, weather conditions play a key role. The various weather parameters recorded during 2015 crop season presented in Table 3.1 and Fig. 3.1 revealed that crop season was favourable for the successful cultivation of kharif okra. All these provided congenial weather conditions favoured better growth and development which reflected significantly higher values of most of the important yield attributing components and finally higher green fruit yield. There was no good seasonal rainfall during the crop season, however, no adverse effects
were observed on crop. There were no serious infestation of pests and diseases in the crop, however, precautionary plant protection measures were taken during the crop season. The overall soil conditions at the time of sowing of okra was found to be favourable for good germination and subsequent gap filling helped to maintain the desirable plant population. Consequently, the plant population in all the experimental plots at the time of harvest was uniform (Table 4.1). In general, the weather condition during crop season was normal for potential production of kharif okra. Therefore, results obtained in the present investigation are the effect of treatments employed in the experiment and not obviated by weather or other factors.

5.2 EFFECT OF NITROGEN LEVELS

Nitrogen, among the plant nutrients, has the most profound influence on plant growth. It is major structural constituent of chlorophyll. It is involved in photosynthesis and protein synthesis. It promotes cell division and enlargement, branching, internodes elongation, flowering, fruit setting and other such development processes (Chandra, 1990). Thus, the need of nitrogen by any plant is much more for performing the several functions like growth and yields. Therefore, application of nitrogenous fertilizers is bound to affect the production parameters in okra crop.
5.2.1 Plant population

Different levels of nitrogen failed to show their significant effect on plant population (Table 4.1). It was indicated that numerically plant population at 30 DAS and at harvest of the crop were highest in treatment $N_4$ (150 kg N ha$^{-1}$).

5.2.2 Growth attributes

In present investigation, application of 150 kg N ha$^{-1}$ ($N_4$) produced significantly the tallest plant at harvest as compared to 75 and 100 kg N ha$^{-1}$ (Table 4.2, Fig. 4.1 and plate 2). However it was at par with 125 kg N ha$^{-1}$ ($N_3$). While, the smallest plant was recorded under the lowest level of nitrogen application ($N_1$). The higher plant height under higher levels of nitrogen might be attributed to increased availability of nitrogen which structural component of protein molecules and protoplasm which might have increased synthesis of protein and carbohydrates in favour of increasing cell division and elongation under sufficient nitrogen supply. These results are in conformity with the findings of Dwivedi et al. (1994), Ahmed and Tanki (1997), Ram et al. (1999), Paliwal et al. (1999), Ambare et al. (2005), Firoz (2009) and Nandal et al. (2010).

The result in (Table 4.3) respect of days to initiation of flowering indicated that flowering prolonged with application of nitrogen. Significantly days to initiation of flowering delayed under the treatment $N_4$ (150 kg ha$^{-1}$) than treatment $N_1$ (75 kg ha$^{-1}$) except treatment $N_2$ (100
kg ha\(^{-1}\)) and N\(_3\) (125 kg ha\(^{-1}\)) which was on par. The more days to initiation of flowering under treatments N\(_4\) and N\(_3\) may be due to increase cell division and formation of more tissues so, the vegetative growth prolonged and ultimate increased the days to initiation of flowering. These observations are in confirmation with the findings of Ambare et al. (2005).

Each incremental dose of nitrogen (from 75 to 150 kg ha\(^{-1}\)) significantly increased the number of branches plant\(^{-1}\) (Table 4.3). The higher number of branches plant\(^{-1}\) (5.12) was observed under the application of 150 kg N ha\(^{-1}\) (N\(_4\)). However it was at par with 125 kg N ha\(^{-1}\) (N\(_3\)). The higher number of branches plant\(^{-1}\) under higher levels of nitrogen might be due to higher nitrogen stimulated the assimilation of carbohydrates and proteins which in turn enhanced cell division and formation of more tissues resulting in luxuriant vegetative growth and more number of branches plant\(^{-1}\). While, the least branched plant\(^{-1}\) (2.39) was seen under the application of 75 kg N ha\(^{-1}\) (N\(_1\)). The results confirm the findings of Dwivedi et al. (1994), Ahmed and Tanki (1997), Ram et al. (1999), Paliwal et al. (1999), Ambare et al. (2005) and Firoz (2009).

### 5.2.3 Yield attributes and yield

Nitrogen is the primary essential element for the growth, development and yield of okra crop. Superior vegetative growth due to increase in dose of nitrogen fertilizer as realized in the present
Plate 2: Crop growth under different treatment combinations at 45 DAS
investigation would obviously improve the yield attributes and thereby yield.

Higher number of pods plant\(^{-1}\) (Table 4.6 and Fig. 4.2) were recorded under application of 125 and 150 kg N ha\(^{-1}\) as compared to other levels of nitrogen (75 and 100 kg N ha\(^{-1}\)), while the lowest value of number of pods plant\(^{-1}\) was observed under 75 kg N ha\(^{-1}\). The higher number of pods plant\(^{-1}\) under increased level of nitrogen may be due to higher vigour of the plant and utilization of proteineous metabolites for build up of new tissues. These results are in agreement with those reported by Pandey et al. (1980), Singh and Pandita (1981), Mishra and Pandey (1987), Naik and Srinivas (1992), Fageria et al. (1993), Singh (1995), Sontakke (1996), Bhat and Dhar (1999), Prasad and Singh (2001), Singh et al. (2012) and Deepika et al. (2015).

The significantly the higher length of pod was observed under application of higher dose of nitrogen (N\(_3\) and N\(_4\)) as compared to N\(_1\) and N\(_2\) (Table 4.10, Fig. 4.3 and plate 3). Per cent increase in length of pod under the treatment N\(_4\) was 11.40 as compared to N\(_1\) treatment. More length of pod under treatment N\(_4\) might be due to rapid cell multiplication and cell elongation under sufficient nitrogen supply. These results are tally with findings by Pandey et al. (1980), Naik and Srinivas (1992), Fageria et al. (1993), Singh (1995), Sontakke (1996), Shanke et al. (2003), Suthar et al. (2009) and Deepika et al. (2015).
Plate 4: Pod length (cm) under different treatment combinations
Increase in dose of nitrogen up to 150 kg N ha\(^{-1}\) increase pod girth (Table 4.13 and Fig. 4.4). The thinnest pod was observed under application of 75 kg ha\(^{-1}\) (N\(_1\)). The per cent increase in girth of pod was 16.59 and 15.48 under 150 and 125 kg N ha\(^{-1}\), respectively, over 75 kg N ha\(^{-1}\). This might be due to better nourishment of plant under higher level of nitrogen produced bolder seeds (Table 4.13) ultimately improved the girth of pod. These results are in agreement with those reported by Fagaria et al. (1993), Suthar et al. (2009) and Deepika et al. (2015).

Significantly higher weight of pod plant\(^{-1}\) (400.49 g) of okra fruit were obtained under the treatment N\(_4\) (150 kg N ha\(^{-1}\)) (Table 4.16 and fig. 4.5). However, it was at par with treatment N\(_3\) 125 kg N ha\(^{-1}\). The lowest weight of pod plant\(^{-1}\) (162.44 g) was recorded under application of 75 kg N ha\(^{-1}\) (N\(_1\)). These results are in conformity with findings of those reported by Singh et al. (2008) and Suthar et al. (2009).

The results in respect of green pod yield (Table 4.18 and Fig. 4.6) revealed that nitrogen levels had pronounced effect on green pod yield. Nitrogen application @ 150 kg ha\(^{-1}\) (N\(_4\)) produced significantly the higher green pod yield (147.31 q ha\(^{-1}\)). The lowest green pod yield (73.02 q ha\(^{-1}\)) was recorded under application of 75 kg N ha\(^{-1}\) (N\(_1\)). The increase in green pod yield was recorded under treatment N\(_4\) was 64.15 per cent over treatment N\(_1\). More green pod yield at higher dose of nitrogen was due to more vegetative growth resulting from efficient utilization of nutrients,
Discussion

Water, radiation and increased metabolic activities followed by increased translocation toward yield contributing characters and thereby increased plant height (Table 4.2 and Fig. 4.1), number of pods plant$^{-1}$ (Table 4.6 and Fig. 4.2), length and girth of pod (Table 4.10 and 4.13 and Fig. 4.3), These results are in conformity with findings of those reported by Pandey et al. (1980), Mishra and Pandey (1987), Naik and Srinivas (1992), Singh (1995), Sontakke et al. (1996), Shanke et al. (2003), Suthar et al. (2009), Singh et al. (2012) and Deepika et al. (2015).

5.2.4 Quality parameters

In the study, different nitrogen levels did not showed their significant influence on moisture and mucilage content (Table 4.20) in okra fruit but the total chlorophyll content in okra fruit remained significant (Table 4.20). Significantly higher total chlorophyll content in okra fruit was recorded under treatment N$_4$ (150 kg N ha$^{-1}$) as compared to rest of the treatments. The lowest total chlorophyll content in okra fruit was recorded under treatment N$_1$ (75 kg N ha$^{-1}$). It might be due to nitrogen as the constitute of chlorophyll content and the synthesis of amino acid, protein and chlorophyll is accelerated with the greater nitrogen supply. These results are in conformity with the findings of Paliwal et al. (1999).
5.2.5 Chemical parameters

In the study, different nitrogen levels did not show their significant influence on organic carbon, available phosphorus and potassium status (Table 4.21) in soil after harvesting of crop but the available nitrogen in soil after harvesting of crop remained significant (Table 4.21).

An application of nitrogen brought out non significant variation in phosphorus and potash content in plant (Table 4.22) but the nitrogen content in plant remained significant (Table 4.22). The significantly the higher nitrogen content in plant was recorded under the treatment N₄ (150 kg ha⁻¹). However, it was at par with treatment N₃ (125 kg ha⁻¹). Increase in nitrogen content under treatment N₄ could be due to more quantity of nitrogen application enhanced green fruit yield and ultimately helped in increase of nitrogen content in plant.

5.3 EFFECT OF POTASH LEVELS

5.3.1 Plant population

The plant population per net plot recorded at 30 DAS and at harvest of the crop was not significantly affected due to the different levels of potash.
5.3.2 Growth attributes

Data revealed that plant height (Table 4.2 and fig. 4.1) measured at 30 DAS and at harvest was not influenced by different levels of potash. It indicated failed to exert significant influence due to different levels of potash.

Data given in Table 4.3 indicated that the differences in days to initiation of flowering were not changed significantly due to different levels of potash.

The results with respect to number of branches plant\(^{-1}\) visualized that different potash levels exerted their significant influence on number of branches plant\(^{-1}\) (Table 4.3). Treatment K\(_5\) (37.5 kg K\(_2\)O ha\(^{-1}\) at basal + 37.5 kg K\(_2\)O ha\(^{-1}\) at 45 DAS) produced significantly higher number of branches plant\(^{-1}\) and it was at par with treatment K\(_4\) (25 kg K\(_2\)O ha\(^{-1}\) at basal + 25 kg K\(_2\)O ha\(^{-1}\) at 45 DAS) and treatment K\(_3\) (75 kg K\(_2\)O ha\(^{-1}\)). The favourable effect of potash on number of branches plant\(^{-1}\) could be ascribed due to continuous supply of potash improve such physiological characteristics as stomatal resistance, relative water content and chlorophyll content which might have improved the overall plant water status and metabolism activities in the plant system as well as cell elongation, bending, division, reproductive and vascular development in plant, which ultimately increased the number of branches plant\(^{-1}\). These
finding are in accordance with those reported by Singh et al. (1998), Nandal et al., (1998) and Mushtaq et al. (2014).

5.3.3 Yield attributes and yield

Yield of crop is a complex function of metabolic and biochemical processes taking place in a plant system which may be modified by the environment and the suitable cultural practices adopted in the cultivation of the crop. Generally, economic yield depends on the fruiting organs produced by a plant. In okra, green fruit yield depends mostly on number of pods plant\(^{-1}\), length, girth and weight of pod plant\(^{-1}\).

Number of pods plant\(^{-1}\) counted at different picking (Table 4.4, 4.5, 4.6 and Fig. 4.2) were significantly influenced by different potash levels. The application of 37.5 kg K\(_2\)O ha\(^{-1}\) at basal + 37.5 kg K\(_2\)O ha\(^{-1}\) at 45 DAS produced significantly higher number of pods plant\(^{-1}\) (36.81) as compared to application of 25 kg K\(_2\)O ha\(^{-1}\) (K\(_1\)) and 50 kg K\(_2\)O ha\(^{-1}\) (K\(_2\)). The treatments K\(_3\) and K\(_4\) were at par with K\(_5\). This might be due to continuous supply of potash rich soil environment because of presence of sufficient K\(_2\)O which promoted plant vegetative as well as reproductive growth process. The increase in number of pods plant\(^{-1}\) of okra due to potash levels has been also reported by Singh et al. (1998), Majumdar and Singh (2001), Prabhavathi et al. (2008) and Pushpavalli et al. (2014).
Data presented in Table 4.8, 4.9, 4.10 and Fig. 4.3 showed that pod length was significantly affected due to different levels of potash. Significantly, the higher pod length was recorded under the treatment $K_5$ (10.51 cm). The lower length of pod recorded under treatment $K_1$. The treatment $K_4$ and treatment $K_3$ was at par with treatment $K_5$. The higher pod length was recorded under the treatment $K_5$ might be due to the continuous supply of potash increased water stress resistance through its functions in stomatal regulation, osmoregulation, energy status and photosynthesis resulting better development of reproductive structures of the crop and ultimately increased the length of pod. The results are confirmed by finding of Singh et al. (1998) and Mushtaq et al. (2014).

The pod girth was affected significantly due to potash levels (4.11, 4.12, 4.13 and fig. 4.4). Higher values of pod girth (4.60 cm) was observed under treatment $K_5$ (37.5 kg K$_2$O ha$^{-1}$ at basal + 37.5 kg K$_2$O ha$^{-1}$ at 45 DAS) in all picking. However, it was at par with treatment $K_4$ (25 kg K$_2$O ha$^{-1}$ at basal + 25 kg K$_2$O ha$^{-1}$ at 45 DAS) and treatment $K_3$ (75 kg K$_2$O ha$^{-1}$) in all picking. The lower of pod girth (4.19 cm) registered under the treatment $K_1$ (25 kg K$_2$O ha$^{-1}$). Similar findings were also reported by Singh et al. (1998) and Mushtaq et al. (2014).

Different potash levels had significant effect on weight of pod plant$^{-1}$ of okra (Table 4.14, 4.15, 4.16 and Fig. 4.5). Treatment $K_5$ (37.5 kg K$_2$O ha$^{-1}$ at basal + 37.5 kg K$_2$O ha$^{-1}$ at 45 DAS) recorded significantly
higher (333.35 g) weight of pod plant\(^{-1}\) over treatments K\(_1\) (25 kg K\(_2\)O ha\(^{-1}\)). However remained at par with treatment K\(_4\) (25 kg K\(_2\)O ha\(^{-1}\) at basal + 25 kg K\(_2\)O ha\(^{-1}\) at 45 DAS) and treatment K\(_3\) (75 kg K\(_2\)O ha\(^{-1}\)). Hassan et al. (1995), Nandal et al. (1998), Singh et al. (1998), and Mushtaq et al. (2014) also reported the higher value of weight of pod plant\(^{-1}\) okra with the higher levels of potash.

Significantly the higher green pod yield of okra was recorded under treatment K\(_5\) (37.5 kg K\(_2\)O ha\(^{-1}\) at basal + 37.5 kg K\(_2\)O ha\(^{-1}\) at 45 DAS). (Table 4.18 and fig. 4.6) However, it was at par with treatment K\(_4\) (25 kg K\(_2\)O ha\(^{-1}\) at basal + 25 kg K\(_2\)O ha\(^{-1}\) at 45 DAS) and treatment K\(_3\) (75 kg K\(_2\)O ha\(^{-1}\)) in different picking. Treatment K\(_1\) registered significantly the lowest green pod yield (101.54 q ha\(^{-1}\)). This showed that there was a significant improvement in growth and yield attributes due to split application potash might probably due to better translocation and partitioning of assimilates toward the sink at proper doses of potash. In fact potash application is known to improve the physiological and metabolic processes and translocation resulted in increase growth and yield attributes and there by increased green pod yield. The finding on higher green pod yields due to different levels of potash were also reported by Singh et al. (1998), Khan et al. (2014), Mushtaq et al. (2014) and Pushpavalli et al. (2014).
5.3.4 Quality parameters

In the study, different potash levels showed their significant influence on total chlorophyll content and mucilage content (Table 4.20) in okra fruit. Significantly higher total chlorophyll content and mucilage content in okra fruit was recorded under treatment K$_5$ (37.5 kg K$_2$O ha$^{-1}$ at basal + 37.5 kg K$_2$O ha$^{-1}$ at 45 DAS). However, it was at par with treatment K$_4$ (25 kg K$_2$O ha$^{-1}$ at basal + 25 kg K$_2$O ha$^{-1}$ at 45 DAS). The lower moisture percentage, total chlorophyll and mucilage content in okra fruit was recorded under treatment K$_1$ (25 kg K$_2$O ha$^{-1}$). It might be due to potash increase the photosynthesis and enzymatic activities in plant. The results are confirmed by finding of Deepika et al. (2015).

5.3.5 Chemical parameters

In the study, different levels of potash did not show any significant influence on organic carbon, available nitrogen and available phosphorus in soil after harvest of okra (Table 4.21 and Table 4.12).

While, significant influence was observed due to potash application on K status of soil after the harvesting of crop. Significantly the highest K status of soil (260.20 kg ha$^{-1}$) after harvest was recorded under the treatment K$_5$ (37.5 kg K$_2$O ha$^{-1}$ at basal + 37.5 kg K$_2$O ha$^{-1}$ at 45 DAS). Significantly the lower K status of soil after harvest (228.15 kg ha$^{-1}$) was recorded under the treatment K$_1$ (25 kg K$_2$O ha$^{-1}$).
Potash content in plant (Table 4.22) was significantly influence due to potash levels. Increase in potash content under treatment K$_5$ could be due to split application of potash enhanced potash availability at later stage of growth and ultimately increased green fruit yield (Table 4.22) and helped in increase of potash content in plant.

5.4 INTERACTION EFFECT OF NITROGEN AND POTASH LEVELS

In present investigation, different levels of nitrogen and potash were studied to find out the response on *kharif* okra. The interaction effects those were found significant are only discussed below.

5.4.1 Yield attributes and yield

Number of pods plant$^{-1}$ (Table 4.7) was significantly influence due to interaction effect of nitrogen and potash levels. Treatment combination (N$_4$K$_5$) gave significantly higher number of pods plant$^{-1}$ (46.94) than others. But, it was at par with treatment combination N$_4$K$_4$, N$_4$K$_3$, N$_3$K$_5$, N$_3$K$_4$ and N$_3$K$_3$. This might be due to synergistic effect of different levels of nitrogen and potash. The maximum number of pods plant$^{-1}$ was recorded in treatment N$_4$K$_5$, it might be due to increased metabolic activities followed by increased translocation and improve the physiological and metabolic processes and translocation resulted in increased number of pod plant$^{-1}$. These results are in agreement with those of Mani and Ramanathan (1980).
Weight of pod plant$^{-1}$ was significantly influenced due to interaction effect between nitrogen and potash levels (Table 4.17). Treatment combination $N_4K_5$ produced significantly higher weight of pod plant$^{-1}$ (455.65 g) over rest of the treatment combinations, but it was at par with treatment combinations $N_4K_4$, $N_4K_3$, $N_3K_5$, $N_3K_4$ and $N_3K_3$. These might be due to increased availability of nutrients as well as improve physiological and metabolic processes.

The results presented in Table 4.19 and depicted in plate 3 revealed that significantly higher green pod yield was recorded under treatment combination $N_4K_5$ (167.45 q ha$^{-1}$) as compared to rest of the treatment combinations but it was at par with treatment combinations $N_4K_4$, $N_4K_3$, $N_3K_5$, $N_3K_4$ and $N_3K_3$. The higher green pod yield under treatment combination $N_4K_5$ might be due to synergic interactive effect of nitrogen and potash levels. This might be due to interactive effect of nitrogen and potash levels of more green pod yield at higher dose of nitrogen and potash was due to more vegetative growth resulting from efficient utilization of nutrient, water, radiation and increased metabolic activities followed by increased translocation toward yield contribution characteristics. Also potash application improve physiological and metabolic process and translocation resulted in increased growth and yield attributes and there by increased green pod yield in okra were also reported by Mani and Ramanathan (1980).
Plate 3: Crop growth under different treatment combinations at 60 DAS
5.5 EFFECT OF TREATMENT ON ECONOMICS

It is necessary to work out economics of the treatment for sound recommendation. Sometimes, the most effective treatment may become uneconomical due to high cost. An average economics as influenced by different levels of nitrogen and potash is furnished in Table 4.23 and 4.24.

5.5.1 Effect of nitrogen levels

The results pertaining to benefit: cost analysis of the crop as influenced by nitrogen levels (Table 4.23) indicated that there was increased net realization with increase nitrogen levels. Application of 150 kg N ha\(^{-1}\) (N\(_4\)) registered maximum net realization (₹ 232731 ha\(^{-1}\)) with BCR value of 3.76, application of 125 kg N ha\(^{-1}\) (N\(_3\)) recorded ₹ 227137 ha\(^{-1}\) net profit with the BCR of 3.69. The lowest net realization ₹ 85130 ha\(^{-1}\) was noticed under application of 75 kg N ha\(^{-1}\) (N\(_1\)) with 1.39 BCR value. The increased net realization with increasing levels of nitrogen was due to increased growth and yield attributing characters and ultimately green pod yield (Table 4.18 and Fig. 4.6). The similar results were reported by Firoz (2009) and Suthar (2009).

5.5.2 Effect of potash levels

Data presented in Table 4.23 revealed that maximum net realization was accured under treatment K\(_5\) (37.5 kg K\(_2\)O ha\(^{-1}\) at basal
+ 37.5 kg K₂O ha⁻¹ at 45 DAS) ₹ 203149 ha⁻¹ with the highest BCR value of 3.27 followed by K4 treatment with ₹ 199915 ha⁻¹ net realization and 3.25 BCR value. The lowest net realization (₹ 142442 ha⁻¹) was recorded under the treatment K₁ with 2.35 BCR value. The higher net realization under treatment K₃ was only due to higher green pod yield (Table 4.18).

5.5.3. Interaction effects of different nitrogen and potash levels

Data on economics as influenced by interaction effects between different levels of nitrogen and potash (Table 4.24) indicated that 150 kg N ha⁻¹ as well as 37.5 kg K₂O ha⁻¹ at basal + 37.5 kg K₂O ha⁻¹ at 45 DAS. (N₄K₅) recorded the highest net realization (₹ 270772 ha⁻¹) followed by treatment combination N₄K₄ recorded the net realization (₹ 267369 ha⁻¹) and treatment combination N₃K₄, recorded the net realization (₹ 267195 ha⁻¹). The lowest net realization was noted under the treatment combination N₁K₁ with ₹ 69886 ha⁻¹. The higher net realization value under treatment combinations N₄K₅, N₄K₄ and N₃K₄ was only due to higher green pod yield and lower total cost than other treatment combinations.
Summary
and
Conclusion
VI. SUMMARY AND CONCLUSION

Okra (*Abelmoschus esculentus* L. Moench) is one of the most important vegetable crops raised on different agro-climatic regions under varied soil and weather conditions. A field experiment was conducted on loamy sand soil of the Main Vegetable Research Station, Anand Agricultural University, Anand to study the “**Effect of nitrogen and potash levels on growth and green fruit yield of okra (*Abelmoschus esculentus* L. Moench) during kharif season under middle Gujarat conditions**” during the year 2015. Twenty treatments comprising of all possible combinations of four nitrogen levels and five potash levels were tested in a randomized block design with factorial concept in three replications. The research findings from the present investigation are summarized under the following sub-heads.

6.1 **Effect of nitrogen levels**

6.2 **Effect of potash levels**

6.3 **Interaction effect of nitrogen and potash levels**

6.4 **Economics**

6.1 **Effect of nitrogen levels**

Plant population of okra at Initial and harvest was not influenced significantly due to nitrogen levels.
Plant height of okra at 30 DAS was not influenced significantly due to nitrogen levels. Application of nitrogen @ 150 kg ha\(^{-1}\) (N\(_4\)) recorded significantly higher values of plant height at harvest. The lowest values of plant height at harvest were recorded under lower application of nitrogen (N\(_1\)).

Days to initiation of flowering was recorded maximum (44.69) under application of 150 kg N ha\(^{-1}\) followed by 125 kg N ha\(^{-1}\) (N\(_3\)).

Number of branches plant\(^{-1}\) (5.12) was significantly higher under application of 150 kg N ha\(^{-1}\) (N\(_4\)) than 75 kg N ha\(^{-1}\) (N\(_1\)).

Number of pods plant\(^{-1}\) (42.25), length (11.40 cm) and girth (4.62 cm) of pod, weight of pods plant\(^{-1}\) (400.49 g) recorded maximum under the treatment N\(_4\) (150 kg N ha\(^{-1}\)) while, the lowest number of pods plant\(^{-1}\), length and girth of pod and weight of pods plant\(^{-1}\) were observed under the treatment N\(_1\) (75 kg N ha\(^{-1}\)).

Application of nitrogen at 150 kg N ha\(^{-1}\) (N\(_4\)) recorded maximum green pod yield (147.32 q ha\(^{-1}\)), while minimum values of those traits were recorded under 75 kg N ha\(^{-1}\) (N\(_1\)).

Different treatments of nitrogen levels failed to show their significant influence on moisture percentage and mucilage content but total chlorophyll content remained significant. Significantly the higher
total chlorophyll content was recorded under the treatment N₄ (150 kg N ha⁻¹) followed by treatment N₃ (125 kg N ha⁻¹).

Different treatments of nitrogen levels failed to show their significant influence on organic carbon, available phosphorus and potassium in soil after harvest of the crop but available nitrogen status of soil remained significant. Significantly the higher available nitrogen was recorded under the treatment N₄ (150 kg N ha⁻¹) followed by treatment N₃ (125 kg N ha⁻¹). Nitrogen content in plant were recorded maximum under 150 kg N ha⁻¹ (N₄) followed by 125 kg N ha⁻¹ (N₃).

6.2 Effect of potash levels

The different levels of potash had their non-significant influence on plant population recorded at initial and harvest.

Plant height (cm) measured at 30 DAS and at harvest were non-significant due to the different levels of potash.

Days to initiation of flowering was not significantly affected due to the different levels of potash. Lower quantity of potash (K₁) took less days to initiation of flowering (42.79 days).

The effect of different levels of potash on number of branches plant⁻¹ was significant. The highest number of branches plant⁻¹ (4.31) was recorded under the treatment K₅ (37.5 kg K₂O ha⁻¹ at basal + 37.5 kg K₂O ha⁻¹ at 45 DAS) followed by treatment K₄ and K₃.
Number of pods plant\(^{-1}\) (36.81) was recorded maximum under treatment K\(_5\) (37.5 kg K\(_2\)O ha\(^{-1}\) at basal + 37.5 kg K\(_2\)O ha\(^{-1}\) at 45 DAS) followed by treatment K\(_4\) and K\(_3\).

Treatment K\(_5\) (37.5 kg K\(_2\)O ha\(^{-1}\) at basal + 37.5 kg K\(_2\)O ha\(^{-1}\) at 45 DAS) registered the higher length of pod (10.51 cm) and girth (4.60 cm) followed by treatment K\(_4\) (25 kg K\(_2\)O ha\(^{-1}\) at basal + 25 kg K\(_2\)O ha\(^{-1}\) at 45 DAS) and treatment K\(_3\) (75 kg K\(_2\)O ha\(^{-1}\)).

Weight of pod plant\(^{-1}\) (333.35 g) were recorded maximum under treatment K\(_5\) (37.5 kg K\(_2\)O ha\(^{-1}\) at basal + 37.5 kg K\(_2\)O ha\(^{-1}\) at 45 DAS) followed by treatment K\(_4\) (25 kg K\(_2\)O ha\(^{-1}\) at basal + 25 kg K\(_2\)O ha\(^{-1}\) at 45 DAS) and treatment K\(_3\) (75 kg K\(_2\)O ha\(^{-1}\)).

Significantly the higher green pod yield (132.59 q ha\(^{-1}\)) was recorded under the treatment K\(_5\) (37.5 kg K\(_2\)O ha\(^{-1}\) at basal + 37.5 kg K\(_2\)O ha\(^{-1}\) at 45 DAS) followed by treatment K\(_4\) (25 kg K\(_2\)O ha\(^{-1}\) at basal + 25 kg K\(_2\)O ha\(^{-1}\) at 45 DAS) and treatment K\(_3\) (75 kg K\(_2\)O ha\(^{-1}\)). The lower green pod yield (101.54 q ha\(^{-1}\)) was observed under the treatment K\(_1\) (25 kg K\(_2\)O ha\(^{-1}\)).

Different treatments of potash levels failed to show their significant influence on moisture percentage but mucilage content and total chlorophyll content remained significant. Significantly the higher total chlorophyll content and mucilage content was recorded under the treatment K\(_5\) (37.5 kg K\(_2\)O ha\(^{-1}\) at basal + 37.5 kg K\(_2\)O ha\(^{-1}\) at 45 DAS).
followed by treatment K\textsubscript{4} (25 kg K\textsubscript{2}O ha\textsuperscript{-1} at basal + 25 kg K\textsubscript{2}O ha\textsuperscript{-1} at 45 DAS) and treatment K\textsubscript{3} (75 kg K\textsubscript{2}O ha\textsuperscript{-1}).

Different levels of potash did not show their significant influence on soil organic carbon, available nitrogen and available phosphorus from soil but available potash of soil remained significant. Significantly the highest available potash was recorded under the treatment K\textsubscript{5} (37.5 kg K\textsubscript{2}O ha\textsuperscript{-1} at basal + 37.5 kg K\textsubscript{2}O ha\textsuperscript{-1} at 45 DAS). The nitrogen and phosphorus content in plant observed non-significant but potash content of plant were recorded maximum under the treatment K\textsubscript{5} (37.5 kg K\textsubscript{2}O ha\textsuperscript{-1} at basal + 37.5 kg K\textsubscript{2}O ha\textsuperscript{-1} at 45 DAS) followed by treatment K\textsubscript{4} (25 kg K\textsubscript{2}O ha\textsuperscript{-1} at basal + 25 kg K\textsubscript{2}O ha\textsuperscript{-1} at 45 DAS) and treatment K\textsubscript{3} (75 kg K\textsubscript{2}O ha\textsuperscript{-1}).

6.3 Interaction effect of different levels of nitrogen and potash

Significantly higher number of pods plant\textsuperscript{-1} (46.94) was recorded under the treatment combinations N\textsubscript{4}K\textsubscript{5} (150 kg N ha\textsuperscript{-1} + 37.5 kg K\textsubscript{2}O ha\textsuperscript{-1} at basal + 37.5 kg K\textsubscript{2}O ha\textsuperscript{-1} at 45 DAS) as compared to rest of the treatment combination but it was at par with N\textsubscript{4}K\textsubscript{4}, N\textsubscript{4}K\textsubscript{3}, N\textsubscript{3}K\textsubscript{5}, N\textsubscript{3}K\textsubscript{4} and N\textsubscript{3}K\textsubscript{3} treatment combinations.

Weight of pod plant\textsuperscript{-1} was recorded maximum (455.65 g) under treatment combination of N\textsubscript{4}K\textsubscript{5} (150 kg N ha\textsuperscript{-1} + 37.5 kg K\textsubscript{2}O ha\textsuperscript{-1} at basal + 37.5 kg K\textsubscript{2}O ha\textsuperscript{-1} at 45 DAS) as compared to rest of the treatment
combinations but it was at par with N₄K₄, N₄K₃, N₃K₅, N₃K₄ and N₃K₃ treatment combinations.

Green pod yield was remarkably influenced by interaction effect of nitrogen and potash levels. Treatment combination N₄K₅ recorded significantly higher green pod yield (167.45 q ha⁻¹) as compared to rest of the treatment combinations barring treatment combination N₄K₄, N₄K₃, N₃K₅, N₃K₄ and N₃K₃.

6.4. Economics

6.4.1. Effect of nitrogen levels

Application of 150 kg N ha⁻¹ (N₄) registered maximum net realization (₹ 232731 ha⁻¹) with BCR value of 3.76. The lowest net realization ₹ 85130 ha⁻¹ was noticed under application of 75 kg N ha⁻¹ (N₁) with 1.39 BCR value.

6.4.1. Effect of potash levels

The treatment K₅ (37.5 kg K₂O ha⁻¹ at basal + 37.5 kg K₂O ha⁻¹ at 45 DAS) registered maximum net realization (₹ 203149 ha⁻¹) with the highest BCR value of 3.27. The next best treatment in order of net realization was K₄ (25 kg K₂O ha⁻¹ at basal + 25 kg K₂O ha⁻¹ at 45 DAS) which recorded the net gain of ₹ 199915 ha⁻¹ with BCR value of 3.25. The lowest net realization (₹ 142442 ha⁻¹) was recorded under the treatment K₁ with 2.30 BCR value.
6.4.3. Effect of different combinations

The application of 150 kg N ha\(^{-1}\) and 37.5 kg K\(_2\)O ha\(^{-1}\) at basal + 37.5 kg K\(_2\)O ha\(^{-1}\) at 45 DAS (N\(_4\)K\(_3\)) recorded the highest net realization ₹ 270772 ha\(^{-1}\) with BCR value 4.23 followed by application of 150 kg N ha\(^{-1}\) and 25 kg K\(_2\)O ha\(^{-1}\) at basal + 25 kg K\(_2\)O ha\(^{-1}\) at 45 DAS (N\(_4\)K\(_4\)) recorded the net realization ₹ 267369 ha\(^{-1}\) with BCR value 4.21 and application of 150 kg N ha\(^{-1}\) and 25 kg K\(_2\)O ha\(^{-1}\) at basal + 25 kg K\(_2\)O ha\(^{-1}\) at 45 DAS (N\(_3\)K\(_4\)) recorded the net realization ₹ 267195 ha\(^{-1}\) with BCR value 4.23.

CONCLUSION

In light of the results obtained from this investigation, it is indicated that the application of 125 kg N ha\(^{-1}\) along with 25 kg K\(_2\)O ha\(^{-1}\) as basal + 25 kg K\(_2\)O ha\(^{-1}\) at 45 DAS to \textit{kharif} okra (\textit{cv. Gujarat Anand Okra-5}), produced higher green pod yield and gave maximum net profit.

FUTURE LINE OF WORK

The following suggestions are made for future line of work on the basis of the present findings.

1. The experiment should be repeated for two to three times for evaluating consistency and applicability of the treatments to arrive at valid recommendations.

2. In order to have general recommendation, the same experiment should be conducted in various agro climatic zone of Gujarat.
References


Prasad, Yogesh and Singh, G. (2001). Effect of nutrition and time of sowing on growth and seed production of okra (*Abelmoschus*


APPENDIX – I

Common cost of cultivation of *kharif* okra

[A] Details of common cost of cultivation practices

<table>
<thead>
<tr>
<th>Sr.No</th>
<th>Particulars</th>
<th>Cost (₹ ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Seed (6 kg ha⁻¹) @ ₹ 270 kg⁻¹</td>
<td>1620</td>
</tr>
<tr>
<td>B.</td>
<td><strong>Land Preparation</strong></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Tractor cultivation (4 hrs)</td>
<td>1200</td>
</tr>
<tr>
<td>2.</td>
<td>Harrowing and planking (1 PB, 2 L)</td>
<td>600</td>
</tr>
<tr>
<td>C.</td>
<td><strong>Sowing</strong></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Preparation of beds, bunds, opening of furrow and irrigation channels (1 PB, 6 L)</td>
<td>1200</td>
</tr>
<tr>
<td>2.</td>
<td>Cost of fertilizers: SSP (50 kg ha⁻¹)</td>
<td>2063</td>
</tr>
<tr>
<td>3.</td>
<td>Cost of fertilizer application (1 L)</td>
<td>150</td>
</tr>
<tr>
<td>4.</td>
<td>Seed treatment of Imidaclopride</td>
<td>390</td>
</tr>
<tr>
<td>5.</td>
<td>Four irrigations with application charges (8 L)</td>
<td>3200</td>
</tr>
<tr>
<td>6.</td>
<td>Sowing cost (10 L)</td>
<td>1500</td>
</tr>
<tr>
<td>D.</td>
<td><strong>After care</strong></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Gap filling (2 L)</td>
<td>300</td>
</tr>
<tr>
<td>2.</td>
<td>Hand weeding three times (18 L)</td>
<td>2700</td>
</tr>
<tr>
<td>3.</td>
<td>Interculturing two time (4 L, 2 PB)</td>
<td>1200</td>
</tr>
<tr>
<td>4.</td>
<td>Picking of green pods (240 L)</td>
<td>36000</td>
</tr>
<tr>
<td>5.</td>
<td>Plant protection measures (Furadan, Clorpyriphos, Ekalux, Dimethoate and Nuvan) + Spraying charge (5 L)</td>
<td>3950</td>
</tr>
<tr>
<td>E.</td>
<td>Up rooting of plants (5 L)</td>
<td>750</td>
</tr>
<tr>
<td>F.</td>
<td>Land revenue</td>
<td>75</td>
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<tr>
<td></td>
<td><strong>Total cost (₹)</strong></td>
<td><strong>55698</strong></td>
</tr>
<tr>
<td>G.</td>
<td>3% interest on capital invested for 4 month (12% interest year⁻¹)</td>
<td>2228</td>
</tr>
<tr>
<td>H.</td>
<td>2.5% supervision charge for 4 month (10 % supervision charge year⁻¹)</td>
<td>1857</td>
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<tr>
<td></td>
<td><strong>Total common cost (₹)</strong></td>
<td><strong>59783</strong></td>
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[B] Details of cost of Nitrogen levels

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Quantity of Nitrogen (kg ha⁻¹)</th>
<th>Quantity of Urea (kg ha⁻¹)</th>
<th>Application charge</th>
<th>Cost of treatment (₹ ha⁻¹)</th>
<th>Total Cost (₹ ha⁻¹)</th>
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<tbody>
<tr>
<td>N₁</td>
<td>75</td>
<td>163.04</td>
<td>150</td>
<td>978</td>
<td>1128</td>
</tr>
<tr>
<td>N₂</td>
<td>100</td>
<td>217.39</td>
<td>150</td>
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<tr>
<td>N₃</td>
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<td>271.73</td>
<td>150</td>
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<td>N₄</td>
<td>150</td>
<td>326.08</td>
<td>150</td>
<td>1956</td>
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</table>

[C] Details of cost of Potash levels

<table>
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<tr>
<th>Treatment</th>
<th>Quantity of Potash (kg ha⁻¹)</th>
<th>Quantity of MOP (kg ha⁻¹)</th>
<th>Application Charge</th>
<th>Cost of treatment (₹ ha⁻¹)</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>K₁</td>
<td>25</td>
<td>42</td>
<td>150</td>
<td>705</td>
<td>855</td>
</tr>
<tr>
<td>K₂</td>
<td>50</td>
<td>83</td>
<td>150</td>
<td>1392</td>
<td>1542</td>
</tr>
<tr>
<td>K₃</td>
<td>75</td>
<td>125</td>
<td>150</td>
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<tr>
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<td>83</td>
<td>150</td>
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<td>K₅</td>
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<td>125</td>
<td>150</td>
<td>2098</td>
<td>2248</td>
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</table>

**Note:**

- Urea : ₹ 300 bag⁻¹
- SSP : ₹ 351 bag⁻¹
- MOP : ₹ 840 bag⁻¹
- Seed : ₹ 270 kg⁻¹
- Irrigation : ₹ 500 ha⁻¹
- Furadon : ₹ 84 kg⁻¹
- Imidaclopride : ₹ 2600 lit⁻¹
- Dimethoate : ₹ 300 lit⁻¹
- Quinalphos : ₹ 425 lit⁻¹
- Clorpyriphos : ₹ 200 lit⁻¹
- Pair of Bullock (PB) : ₹ 300 day⁻¹
- Tractor cultivation : ₹ 300 hr⁻¹
- Labour : ₹ 150 day⁻¹
APPENDIX – II

Analysis of variance for Plant population (net plot\(^{-1}\)), plant height (cm), Days to initiation of flowering, Number of branches plant\(^{-1}\), Number of pods plant\(^{-1}\), Pod length (cm) and Pod girth (cm) of okra

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>df</th>
<th>Plant population net plot(^{-1})</th>
<th>Plant height (cm)</th>
<th>Days to initiation of flowering</th>
<th>Number of branches plant(^{-1}) at harvest</th>
<th>Number of pods plant</th>
<th>Pod length (cm)</th>
<th>Pod Girth (cm)</th>
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<td>0.22</td>
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<td></td>
<td>At harvest</td>
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<tr>
<td></td>
<td></td>
<td>At 30 DAS</td>
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<td>At harvest</td>
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APPENDIX-III

Analysis of variance for Weight of pod plant$^{-1}$, Green pod yield (q ha$^{-1}$), Organic carbon (%), Available N (kg ha$^{-1}$), Available P$_2$O$_5$ (kg ha$^{-1}$) and Available K$_2$O (kg ha$^{-1}$) content in soil, Content of N, P and K in plant

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<th>Source of variation</th>
<th>df</th>
<th>Weight of pod plant$^{-1}$</th>
<th>Green pod yield (q ha$^{-1}$)</th>
<th>Organic carbon (%)</th>
<th>Available N (kg ha$^{-1}$)</th>
<th>Available P$_2$O$_5$ (kg ha$^{-1}$)</th>
<th>Available K$_2$O (kg ha$^{-1}$)</th>
<th>N Content (%)</th>
<th>P Content (%)</th>
<th>K Content (%)</th>
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</table>
CERTIFICATE

This is to certify that I have no objection for supplying to any scientist one copy of any part of this thesis for rendering reference service in a library of documentation centre.

Place: Anand
Date: / 07/2016 (Jaymin G. Chaudhari)