EFFECT OF NITROGEN LEVELS AND DETASSELING TIME ON GROWTH, YIELD AND QUALITY OF WINTER BABY CORN (*Zea mays* L.)

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THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

Master of Science (Agriculture)
in
Agronomy

Supervisor
Prof. S. P. Singh

Submitted by
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CERTIFICATE

To
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Through:　The Head,
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Sir,

I have great pleasure in forwarding the thesis entitled **"Effect of nitrogen levels and detasseling time on growth, yield and quality of winter baby corn (*Zea mays* L.)"**, submitted by **Mr. Kadagonda Nithin Kumar**, **ID. No. 20412AGR023**, in partial fulfillment of the requirements for the degree of **Master of Science (Agriculture)** in **Agronomy** of the Banaras Hindu University and placing on record that he has completed the requisite requirements as contained in the statutes of the University.

I certify that the work has been carried out under my guidance and the data forming the basis of the thesis, to the best of my knowledge are original, genuine, and no part of the work has been submitted for any other degree or institution.

Thanking you.

Yours faithfully,

Forwarded by

(Dr. S. P. Singh)
Supervisor

Head

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Dedicated to

My beloved Grand Parents,

Parents

Mr. Kadagonda Gangadhar

Mrs. Kadagonda Vijaya

Supervisor

Prof. S. P. Singh

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Date:
Place: Varanasi **(Kadagonda Nithin Kumar)**

CONTENTS

LIST OF SYMBOLS AND ABBREVIATIONS

%	:	Percentage
@	:	at the rate of
&	:	and
₹	:	Rupees
a.i	:	Active ingredient
ADF	:	Acid-detergent fiber
B: C ratio	:	Benefit: cost ratio
CD	:	Critical Difference
Cm	:	Centi meter
DAE	:	Days after emergence
DAP	:	Diammonium phosphate
DAS	:	Days after sowing
dS/m	:	deci Siemen per meter
EC	:	Electrical conductivity
et al.	:	and others (*et alibi*)
etc.	:	etc. - and so fourth (*et cetera*)
Fig.	:	Figure
g	:	gram
ha^{-1}	:	per hectare
i.e.	:	That is (*id est*)
K	:	Potassium (Kalium)
kg ha^{-1}	:	Kilo gram per hectare
Kg N ha^{-1}	:	Kilo gram nitrogen per hectare
KHS	:	Knee high stage
mm day^{-1}	:	milli meter per day
mg	:	milligram
MOP	:	Murate of potash
N	:	Nitrogen
NDF	:	Neutral detergent fiber
NS	:	Non-significant
$^{\circ}C$	:	degree centigrade
P	:	Phosphorous
R.H.	:	Relative humidity
RDN	:	Recommensded dose of nitrogen
SEm	:	Standard Error of Mean
SPAD	:	Soil plant analysis development
t ha^{-1}	:	tonne per hectare
TE	:	Tassel emergence
viz.	:	Namely (*videlicet*)

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Chapter I

INTRODUCTION

Maize ranks third in order of importance among cereals at global level after wheat and rice; most versatile crop with wider adaptability and high yield ability under varied agro-climatic conditions. Globally maize is cultivated in an area of 193.7 million ha, produces 1147.7 million metric tonnes with an average productivity of 5750 kg ha^{-1} (FAOSTAT, 2020) and contributes 39% of global grain production. Maize is cultivated in country on 9.72 million ha, total production and productivity stands 28.64 million tonnes and 2965 kg ha^{-1}, respectively (Anonymous, 2021). India ranks fourth in area and seventh in production representing around 4% of the world maize area and 2% of the total production. In India, maize is mostly grown as *kharif* or *rabi* season crop in an area around 83% and 17%, respectively. Over 70% of *kharif* maize is grown under rainfed condition facing biotic and abiotic stresses which lowers the productivity (2706 kg ha^{-1}) as compared to *rabi* maize (4436 kg ha^{-1}) grown under assured irrigation (IIMR, 2021).

Globally, baby corn has attracted an increasing number of people's due to shift in their dietary habits; however, the production area is confined to few countries only *viz.* Thailand, Indonesia, Brazil, Taiwan, Sri Lanka and Myanmar. South Africa, Zambia, Zimbabwe and Guatemala have also started its cultivation. The world's top baby corn-producing countries are Thailand and China. Cultivation of baby corn started in India recently for vegetable purposes and the crop provides avenue for diversification and value addition (Neupane *et al*., 2017). Baby corn demand is growing since included in American and European diet however, production is concentrated in Asia. The United States of America is the leading importer from Asian countries, and Thailand alone accounts about 40% of the total baby corn export (Jinjala *et al*., 2016).

Baby corn is new crop to India and its cultivation gradually becoming popular in Punjab, Haryana, Uttar Pradesh, Bihar, Maharashtra, Andhra Pradesh and North eastern region, more particularly in peri-urban areas (Singh *et al*., 2009; Jinjala *et al*., 2016). However, convincing data regarding the area, production and productivity of baby corn in India are currently unavailable.

Baby corn is immature, dehusked maize ear, harvested within 1–2 days of silking at a 2–3 cm long silk stage before fertilization (Singh *et al*., 2010). This crop is highly suitable for diversification being a short duration, fast-growing crop having high production potential with wider adaptability (Neupane *et al*., 2017). Baby corn is highly nutritious, free form cholesterol, contains low calories and high fiber content. It is consumed as raw vegetable, used in various recepies, pickles, soups, pakora, curries, pulav, snacks, salads etc. thus is a good choice for traditional and continental dishes and for canning industry (Singh *et al*., 2010).

Baby corn provides 17.90 g protein, 2.13 g fat, 5.30 g total ash, 5.89 g crude fiber, 23.43 g total soluble sugar, 1.96 g reducing sugar, 15.60 g starch; essential nutrients *viz.* calcium (95 mg), magnesium (345 mg) and phosphorous (898.62 mg), vitamins and amino acids like ß-carotene (670 mg) and ascorbic acid (5.43 mg), methionine (0.05 mg), isoleucine (2.85 mg) and leucine (0.675 mg) per 100 g of dry weight (Hooda and Kawtra, 2013).

Nitrogen (N) is an essential nutrient that tremendously influences the growth, yield and quality of baby corn; involved in the function of amino acids, part of nucleic acid, DNA and RNA, and is building block of protein. Nitrogen plays an important role in chlorophyll formation and fixes atmospheric CO_2 as carbohydrate in presence of solar radiation and is involved in several metabolic and enzymatic reactions in plants (Pal *et al*., 2017). The baby corn is highly responsive to nitrogen and requires more nitrogen to increase the growth, productivity and also to improve soil fertility (Roy *et al*., 2019). Baby corn efficiently utilizes the nitrogen when applied in splits (*i.e*. basal, knee-high stage and at tassel emergence stage) at critical stages. Baby corn yield increases with increase in nitrogen levels due to its high plant density (Imran, 2015). Soil + foliar application (150 kg N ha^{-1}) in split doses to winter season baby corn increased the nitrogen use efficiency, production and productivity (Neupane *et al*., 2017). The supply of N in optimum amount is necessary to harvest maximum. Excess application is not beneficial in terms of yield or monetary gains. The nitrogen requirement may vary with season and addition of lower dose than optimum may restrict the crop growth and yield. Hence, baby corn requires optimum N applied at critical growth stages and its efficient utilization. Application of N near to peak demand and distributed into required number of splits reduce losses and helps in effective utilization. Application of recommended dose of nitrogen (RDN) in 3 splits *i.e*. ½ basal, ¼ 25 DAS and ¼ 45 DAS noticed superior than two splits and improved the cob yield and quality attributes of winter baby corn. Winter baby corn requires more duration and is highly productive compared to rainy season hence needs higher N fertilizer application (Singh *et al.*, 2019).

Baby corn is a monoecious plant and the male flower is known as tassel while female flower is known as silk. Both male and female flowers are born on the same plant at different locations. Removal of the tassel is known as detasseling, which is an important operation in baby corn. During reproductive phase, there is huge competition between tassel and silk for nutrient requirements. Removal of tassel from the plant ultimately cause translocation of nutrients to silk and improves the corn yield in terms of quality and quantity (Cheng and Paredy, 1994). Moreira *et al*. (2010) reported that detasseling operation significantly increases the number and total weight of the ears and also increases the unhusked number and weight of the ears. Detasseling operations are carried out immediately after the emergence of the tassel around 40-45 days after sowing (DAS) depending on variety and environmental conditions (Rani *et al*., 2017). Detasseling immediately after emergence increased the baby corn yield by 18% compared to no detasseling (Singh *et al*., 2019).

Many workers revealed that winter maize shows greater significance in yield. Winter season cultivation of baby corn is superior to the rainy season in terms of baby corn weight and length, and green fodder yield with enhanced quality parameters though it takes more duration to mature due to low temperatures. The response of winter baby corn to levels of nitrogen may differ. No research information available on the effect of detasseling time on baby corn.

There is need to focus on refinement of production technologies of baby corn to increase the yield and economic status of farmers. Baby corn crop cultivation is a relatively new introduction to India and requires more research to identify the new production technologies especially the nitrogen levels and detasseling time to enhance its production in terms of quantity and quality. Analyzing the facts mentioned above, an investigation on "**Effect of nitrogen levels and detasseling time on growth, yield and quality of winter baby corn (*Zea mays* L.)**" was undertaken at the Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, during the winter season of 2021-2022 with following objectives:

1. To ascertain the impact of nitrogen levels on growth and yield of winter season baby corn.
2. To find out the effect of treatments on the nutrient uptake and quality of winter season baby corn.
3. To analyze the economic viability of the treatments.

Chapter II

REVIEW OF LITERATURE

Maize is a unique fast-growing cereal crop with high-yielding ability, adaptability and adjusted to a wide range of environments. Due to its uniqueness, maize is used for multiple purposes in the food industry and provides employment generation to many people's across the world. The success of baby corn began at Taiwan in the late 1960s (Gayatonde *et al.*, 2017) but it is a new introduction to Indian agriculture. Maize and baby corn differs in their agronomical management in certain aspects; hence serious attention needed for refinement of the production technologies of baby corn for its successful cultivation.

Systemic review has been arranged on the work done regarding different levels of nitrogen in baby corn for various regions of the country. However, no work relevant to the effect of detasseling time in baby corn production is available. The chapter includes available reviews of past work done on the research topic "**Effect of nitrogen levels and detasseling time on growth, yield and quality of winter baby corn (*Zea mays* L.)**". Earlier work done by various scientists in the country and across the world has been systematically arranged to have enough opportunity to decide appropriate strategies to achieve the new objectives set up for further investigation. In addition to baby corn, the chapter contains relevant literature on grain maize. The review work has been discussed under the following points:

2.1 Effect of nitrogen levels on baby corn

The baby corn is widely cultivated in tropical, subtropical and temperate regions require more quantity of nitrogen for its production. Nitrogen plays an important role in plant growth and development and is an essential component of amino acids, proteins, nucleic acids, porphyrins, flavins, purines, pyrimidine nucleotides and flavin nucleotides, enzymes, co-enzymes and alkaloids. Nitrogen-containing chlorophyll fixes atmospheric CO_2 as carbohydrates in the presence of solar energy. Nitrogen fertilization improves protein quality of food grains by enhancing the proportion of proline, phenylalanine, glutamic acid, cysteine, tyrosine, methionine etc. Generally, Indian soils are deficient in nitrogen due to high temperature and low in organic matter. High mobility of N in plants causes appearance of deficiency symptoms first on older leaves as light green to pale yellow color (chlorosis). Excess application of nitrogen leads leaching and volatilization losses their by lowers the nitrogen use efficiency (NUE). Organic, inorganic and bio-fertilizers are major sources to supplement nitrogen in the soil (Singh *et al*., 2019; Roy *et al*., 2019). Nitrogen application schedules involving right time, method, and source may improve nitrogen use efficiency in baby corn. The use of a new approach in nitrogen management *i.e.* soil application + foliar has been reported to enhance the yield and quality of baby corn during winter season (Neupane *et al*., 2017). Dawadi and Sah (2012) reported that increasing nitrogen levels in baby corn increases growth, yield and quality parameters.

2.1.1 Effect of nitrogen levels on growth

Ali and Anjum (2017) concluded that the application of four levels of nitrogen (70, 130, 160 and 180 kg ha^{-1}) and control in maize, resulted maximum plant height, stem diameter, leaf area $plant^{-1}$ and chlorophyll content due to application of 180 kg N ha^{-1} as compared to lower levels.

Asaduzzaman *et al*. (2014) revealed that the application of 160 kg N ha^{-1} significantly increases the plant height and dry matter accumulation similar to the 200 kg N ha^{-1}, and the leaf area index recorded the highest value at 200 kg N ha^{-1} in baby corn.

Bindani *et al*. (2007) revealed that application of 120 kg N ha^{-1} significantly increased the baby corn plant height, dry matter yield and leaf area index compared to the 40 and 80 kg N ha^{-1}.

Dar *et al*. (2014) emphasized that adding nitrogen @ 180 kg ha^{-1} exhibited its superiority to enhance plant height, LAI, and the fresh weight $plant^{-1}$ than its lower levels (0 and 60 kg N ha^{-1}).

Da**s** *et al*. (2008) reported that use of 120 kg N ha^{-1} in baby corn planted at 60×15cm significantly increased the plant height, number of leaves and stem girth as compared to 80 kg N ha^{-1} planted at 50×15 cm.

Dawadi and Sah (2012) found that increase in plant density (83,333 plants ha^{-1}) and nitrogen levels up to 200 kg N ha^{-1} increased the growth parameters of baby corn.

Jeet *et al*. (2012) and Reddy *et al*. (2019) also observed that an increase in nitrogen level upto150 kg N ha^{-1} increased the growth attributes of the plant (height, dry weight and leaves $plant^{-1}$) in maize.

Joshi *et al*. (2014) concluded from 2-years experiment that application of 100 kg N ha^{-1} to maize gave significantly higher plant height, number of leaves, leaf area and chlorophyll content at all growth stages than 50 kg N ha^{-1}.

Kaur and Vashisth (2015) reported that application of 150 kg N ha^{-1} gave significantly maximum plant height in maize as compared to the control.

Majid *et al*. (2017) observed that use of nitrogen levels (0, 115, 230 and 345 kg N ha^{-1}) in maize varieties (BARI hybrid maize-7 and BARI hybrid maize-9) resulted significant increase in the plant height of BARI hybrid maize-9 with 345 kg N ha^{-1} as compared to 0 and 115 kg N ha^{-1} to BARI hybrid maize-7.

Pandey *et al*. (2000) observed that application of three levels (60, 90 and 120 kg N ha^{-1}) of nitrogen recorded significantly maximum plant height with the treatment of 120 kg N ha^{-1} as compared to the 90 kg N ha^{-1} in baby corn.

Ramachandiran and Pazhanivelan (2016) observed that 125% RDN (312.5 kg N ha^{-1}) favorably increased the higher growth parameters *viz*. plant height, leaf area index, SPAD meter value and dry matter production than the 100% RDN (250 kg N ha^{-1}) in maize.

Roy *et al*. (2019) revealed that the highest plant height was recorded due to application of 120 kg N ha^{-1} followed by 100 and 80 kg N ha^{-1}, respectively.

Singh *et al*. (2003) noticed that application of 120 kg N ha^{-1} and 70 kg K_2O ha^{-1} recorded significantly higher growth attributes of baby corn over control.

Singh *et al*. (2009) found significant improvement in growth factors and overall dry matter yield of baby corn with a graded increase in the level of N, P and K.

Singh *et al*. (2021) stated that application of 100% NPK (150-60-40 kg ha^{-1}) + Zinc (25 kg ha^{-1}) significantly increased the plant height and number of leaves of maize.

Sobhana *et al*. (2012) at IARI, New Delhi reported that the application of 187.5-32.75-62.5 NPK kg ha^{-1} significantly increased plant height and dry matter $plant^{-1}$ of baby corn over control.

Thakur and Sharma (1999) showed that application of 200 kg N ha^{-1} in 3 splits to baby corn significantly increased the plant height but observed at par to 150 kg N ha^{-1}.

2.1.2 Effect of nitrogen levels on yield

Ali and Anjum (2017) concluded that the application of 160 kg N ha^{-1} in maize showed maximum green fodder yield (44.89 t ha^{-1}) at par to 180 kg N ha^{-1}.

Bindani *et al*. (2007) reported that significant improvement in the baby corn length and girth noticed along with the baby corn and fodder yields due to use of 120 kg N ha^{-1}.

Dar *et al*. (2014) observed that the addition of nitrogen @180 kg N ha^{-1} exerted significant effect and enhanced increased baby cob and baby corn yields. The yields of fodder (green) and fodder (dry) (6.94 t ha^{-1}) also increased in same manner compared to control.

Kar *et al*. (2006) reported that nitrogen addition @ 80 kg ha^{-1} in sweet corn planted at 60×20 cm increased the green cob ha^{-1}, cob length, cob girth, green cob yield and green fodder yield.

Raffin (1992) reported that the application of 180 kg N ha^{-1} resulted an increase in the ears per plant, weight of young cobs which ultimately increased the baby corn yield.

Ramachandrappa *et al*. (2004) revealed that application of 150-75-40 kg NPK ha^{-1} + 10 t farm yard manure (FYM) gave high yield attributes and yields of baby corn and fodder with improvement in the quality of baby corn.

Roy *et al*. (2019) revealed that application of 120 kg N ha^{-1} + 1.5 % Zn significantly increased the number of cobs, cob weight with husk and cob yield ha^{-1} in baby corn.

Sahoo (2011) reported that the yield of baby corn increased linearly with an increase in nitrogen level. Maximum yield of 1.08 ton ha^{-1} (2006) and 1.19 ton ha^{-1} (2007) obtained due to addition of 180 kg N ha^{-1} noted equivalent to 120 kg N ha^{-1}. However, addition of 180 kg N ha^{-1} improved the fodder yield of baby corn over 60 kg N ha^{-1}.

Sahoo and Panda (1999) found that the use of 160 kg N ha^{-1} in baby corn planted at 40×20 cm increased the baby corn yield and green fodder yield.

Singh *et al*. (2021) resulted that application of 100% NPK (150-60-40 kg ha^{-1}) + zinc (25 kg Zn ha^{-1}) significantly increased the baby corn length, baby cobs $plant^{-1}$ and cob yield ha^{-1}.

Srichandan and Mangaraj (2015) reported that the number of baby cobs $plant^{-1}$, green cob with husk, baby corn length, baby corn yield and fodder yield were higher under 90 kg N ha^{-1} when applied 1/3 basal + 1/3 knee height + 1/3 pre tasseling than rest of the treatments.

Thakur and Sharma (1999) observed that application of 200 kg N ha^{-1} in three splits significantly increased the number of ears $plant^{-1}$, ear weight and cob yield with husk, marketable baby corn yield and green fodder yield but noted at par to 150 kg N ha^{-1}.

2.1.3 Effect of nitrogen levels on quality

Ali and Anjum (2017) concluded that the application of 180 kg N ha^{-1} produced significantly maximum crude protein (10.75%), crude fiber (31.87%), and ash (8.85%) as compared to control and 70 kg N ha^{-1} in maize.

Ayub *et al.* (2003) observed that increase in the levels of nitrogen in maize significantly increased the protein content, crude fiber, and total ash content.

Bindani *et al*. (2007) showed that application of 120 kg N ha^{-1} increased protein content (16.19%) and protein yield (127.47 kg ha^{-1}) in baby corn compared to 40 or 80 kg N ha^{-1}.

Dar *et al*. (2014) reported that application of 180 kg N ha^{-1} planted at 60 × 20 cm resulted significant increase in crude protein, ether extract and ash as well as in nitrogen uptake by the plant. However, organic matter, acid detergent fiber, neutral detergent fiber, hemicellulose and dry matter content of baby corn, fodder, cob husk and tassel decreased with increase in the levels of nitrogen.

Da**s** *et al*. (2008) revealed that maximum fat content (0.22 g 100 g^{-1}), ascorbic acid (12.3 mg 100g of cob^{-1}) and carbohydrate content was observed with application of 100 kg N ha^{-1}; and maximum protein (2.06) content, calcium and phosphorous content recorded with use of 120 kg N ha^{-1} in baby corn.

Jeet *et al*. (2012) also reported that protein content in maize significantly responded to N addition up to 150 kg ha^{-1}.

Kar *et al*. (2006) found that application of 80 kg N ha^{-1} significantly increased the protein yield in sweet corn.

Mahdi *et al*. (2012) found that the application of 120 kg N ha^{-1} significantly increased the crude protein and crude fiber content of fodder maize compared to the lower levels of nitrogen.

Ramachandrappa *et al*. (2004) observed that application of 200-100-53 kg NPK ha^{-1} + 10 t FYM ha^{-1} resulted in significantly higher crude protein (13.36%), NDF (69.80%), ADF (52.05%), lignin (9.67%) and lignin/ADF ratio (0.19) compared to the fertility level of 100-50-27 kg NPK ha^{-1} + 10 t FYM ha^{-1} in baby corn.

2.1.4 Effect of nitrogen levels on nutrient uptake

Bindani *et al*. (2007) reported that the application of 120 kg N ha^{-1} increased the nitrogen content in baby corn, fodder and total nitrogen uptake as compared to the 40, 80 kg N ha^{-1}.

2.1.5 Effect of nitrogen levels on the economics

Bindani *et al*. (2007) reported that application of 120 kg N ha^{-1} in 3 splits showed an increase in the gross returns, net returns and benefit: cost ratio as compared to the 40 and 80 kg N ha^{-1} in baby corn.

Dar *et al*. (2014) observed that the application of 180 kg N ha^{-1} in baby corn increased the net returns ((₹155900 ha $^{-1}$) and benefit: cost ratio (2.21) as compared to the control (0 kg N ha^{-1}).

Da**s** *et al*. (2008) observed that the application of 120 kg N ha^{-1}+ 50×15cm gave the maximum net returns (₹ 144900 ha $^{-1}$) and B: C ratio (11.32) in baby corn.

Jeet *et al*. (2012) reported that increasing nitrogen levels up to 150 kg N ha^{-1} significantly enhanced net returns and benefit-cost ratio in quality protein maize.

Mahdi *et al*. (2012) found that the application of 120 kg N ha^{-1} significantly increased the benefit-cost ratio in fodder maize.

Pal *et al*. (2017) reported that the application of 120 kg N ha^{-1} recorded maximum net return (₹ 39228 ha^{-1}) and Benefit: cost ratio (3.14) in maize.

Reddy *et al*. (2019) reported that the application of 150 kg N ha^{-1} gave the higher net returns (₹59108 ha $^{-1}$) and benefit-cost ratio (1.63) as compared to the control with lowest net returns (₹2518.0 ha^{-1}) and benefit-cost ratio (0.08) in maize.

Roy *et al*. (2019) revealed that highest net return (₹ 146134.91 ha^{-1}) found with application of 120 kg N ha^{-1} + 1.5 % Zn in baby corn.

Sahoo (2011) observed that the application of 120 kg N ha^{-1} in baby corn resulted in a higher net profit and benefit: cost ratio during the years 2006 and 2007.

Sahoo and panda (1999) revealed that the application of 160 kg N ha^{-1} with 40 × 20cm increased the net profit and benefit: cost ratio in baby corn.

Sharma *et al*. (2018) found that application of 150 kg N ha^{-1} with 75 kg P_2O_5 recorded maximum gross returns (₹ 117136 ha $^{-1}$), net income (₹ 85812 ha $^{-1}$), and benefit: cost ratio (3.74) in maize.

Singh *et al*. (2012) found that application of 120 kg N ha^{-1} provided maximum net returns and benefit-cost ratio but noted statistically on par with 150 kg N ha^{-1} in sweet corn.

2.2 Effect of detasseling

The maize plant contains male and female flowers both located at different positions (monoecious). Baby corn is an unfertilized small cob and to avoid pollination, removal of male inflorescence is necessary after its emergence from flag leaf. Pollination of ear produces poor quality of baby corn. Detasseling is one of the most important operations in baby corn production which should be done before the formation of pollen in the tassel. This operation in baby corn stimulates the earlier harvesting dates; enhances the prolificacy and increases yield (Aekatasanawan *et al*., 1994). Detasseling operation in baby corn removes the nutritional competition between the tassel and ear (Moreira *et al*., 2010). Detasseling has a greater influence on the yield and yield attributes due to more light interception by flag leaf which is done immediately after emergence thus, increased the baby corn yield by 18% as compared to no detasseling (Singh *et al*., 2019).

2.2.1 Effect of detasseling on yield

Bhargavi *et al*. (2017) observed that detopping done at 30 days after silking significantly increased the yield attributes and grain yield of maize as compared to the 10 days after silking and 20 days after silking. They also reported that detopping done with two leaves increased the yield than the detopping with top four leaves and detopping with top-six leaves.

Ghete *et al*. (2020) reported that detasseling along with leaves of the main ear harmed the ear length and weight, kernels weight ear^{-1} and the number of kernels row^{-1} in maize. They observed that removal of tassel with two leaves resulted decreased ear weight by 10-12% than control. Removal of tassel alone increases the yield and yield attributes of maize as compared to the tassel removed with leaves above the ear and tassel removed with two leaves.

Irfanullah *et al*. (2017) emphasized that detasseling at complete pollen shedding stage produced significantly higher 1000-grains weight, grain yield and biological yield. The interactive effect between detasseling and potassium found significant only for grain yield and they also observed that detasseling at complete pollen shedding stage and potassium (75 kg ha^{-1}) were best to increase the yield and yield attributes of maize.

Luis (1998) reported that removal of tassels both partially or completely could not significantly enhance the yield and yield attributes of maize regardless of plant density or cultivars.

Moreira *et al*. (2010) revealed that detasseling in baby corn resulted increase in the number of ears ha^{-1} (267751), and marketable unhusked ears ha^{-1}(11754 kg) and marketable husked ears ha^{-1} (2138 kg) as compared to the undetasseled baby corn plants.

Raffin (1992) reported that detasseling operations increased the cob and corn yield, and no. of ears plant^{-1} in baby corn.

Sahoo and panda (2001) observed that detasseling results in a significant increase of baby corn yield and green fodder yield when compared to no detasseling.

Sammauria *et al*. (2019) observed that tassel removal at 3 days after emergence (DAE) and 7 DAE showed at par results with respect to cobs plant^{-1}, no. of grains row^{-1}, grains cob^{-1}, 1000-grains, grain yield, stover yield and biological yield compared to the removal just after emergence. They compared the intensity of tassel removal (%) and observed that 50% tassel removal performed significantly better in terms of yield and yield attributes of maize than 25% tassel removal and remained at par with 75% and 100% tassel removal intensities.

2.2.2 Effect of detasseling on nutrient uptake

Bhargavi *et al.* (2017) observed that detopping done at 30 days after silking significantly increased nutrient uptake (43.6 kg N $ha^{-1)}$ as compared to the 10 days after silking and 20 days after silking (34.8 kg N ha^{-1}) in maize. They also reported that detopping with above two leaves increase nutrient uptake as compared to the detopping with top four leaves and detopping with top-six leaves.

Patel *et al.* (2015) observed that detasseling resulted in higher uptake of nutrients *viz.* nitrogen, phosphorus and potassium as compared to no detasseling treatment in maize.

2.2.3 Effect of detasseling on the economics

Sahoo and Panda (2001) reported that application of 26.2 kg P ha^{-1} along with detasseling treatment results highest net returns and benefit: cost ratio in baby corn.

Sammauria *et al*. (2019) observed that tassel removal at 7 DAE showed highest net returns, benefit: cost ratio as compared with tassel removal just after emergence. They observed that 50% tassels removal gave highest net return and B: C ratio in maize.

Chapter III

MATERIALS AND METHODS

The present investigation entitled "**Effect of nitrogen levels and detasseling time on growth, yield and quality of winter baby corn (*Zea mays* L.)"** was executed during 2021-2022 in winter season at Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh (India). The materials used during the course of study, procedures and the techniques followed in entire investigation have been described in this chapter.

3.1 Experimental site

The Agricultural Research Farm is situated at the Institute of Agricultural Sciences, Banaras Hindu University, located on the left bank of the river Ganga in the southern end of Varanasi. The research farm is geographically situated on Northern Gangetic alluvial plains and lies at $25^{o}18'$N latitude and $83^{o}31'$E longitude with an altitude about 75.7 meters above the mean sea level. The experimental site was homogeneous in fertility with even topography, uniform textural makeup having assured irrigation and other required facilities. A proper drainage facility was also provided to remove the excess water if any, during the experimental period.

3.2 Weather and climate

Varanasi city is situated in the eastern part of Utter Pradesh. Climatologically, Varanasi falls under the category of subtropical climate with hot summer and cold winters. This region falls under a semi-arid to the sub-humid type of climate. According to the Agro-Climatic Zones by Planning Commission of India, the experimental site falls under Middle Gangetic Plain Zone (number IV). Usually, the time for onset of monsoon in this area is 3rd week of June to the end of September. However, sometimes it continues up to the first week of October. The area also experiences some winter showers due to western disturbances from December to February. Normally the period between March to May is dry. The average annual rainfall of this region was 1924.6 out of which 1797.3 mm (93.38%) is received during the Southwest monsoon season *i.e*. from June to September and 129.3 mm (6.71%) during the Northeast monsoon season, from October to December. The mean annual potential evapotranspiration (PET) is about 1525 mm. The mean annual moisture deficit of this region is 400 mm and the moisture deficit index ranges from -20 to -40 per cent. The mean annual relative humidity rises to 94 per cent during rainy from June-September and again it declines to 20 per cent by the end of April-June.

In general, the temperature in this region starts to rise in the middle of February and attains maximum by May or the middle of June (mean maximum air temperature is 39 ºC). However, it will decrease again from July onwards and reaches a minimum of 9.3 ºC during December-January. The hottest and coldest months appear during the end of May and January respectively. The maximum air temperature usually ranges from 22 to 42.6 ºC, whereas the minimum air temperature ranges from 8.6 to 29.9 ºC. During the winter season fog is common and while in summer very hot dry winds prevails.

3.3 Climate and weather during the crop period

The details regarding various meteorological parameters *viz*. maximum and minimum temperature, maximum and minimum relative humidity, rainfall, pan evaporation and sunshine duration prevailed during the investigation were recorded on weekly basis at Meteorological Observatory, Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi.

The weather conditions that prevailed during the field experimentation period from November, 2021 to April, 2022 are presented in Table 3.1 and graphically depicted in Fig 3.1.

3.3.1 Rainfall (mm)

The total rainfall received during the experimental period was 9.7 mm (Table 3.1). Crop was sown on residual moisture and one come up irrigation was given just after sowing the test crop. The maximum rainfall (7.0 mm) was recorded during the 4th standard meteorological week.

Table: 3.1 Weekly Meteorological data during the period of experiment (*Rabi*, 2021-22)

Standard Week No.	Month & date	Rainfall (mm)	Temperature (°C)		R.H. (%)		Sunshine (hour)	Wind speed (km hr^{-1})	Evaporation (mm)
			Max.	Min.	Max.	Min.			
47	19 - 25 Nov	0.0	28.7	12.2	90	40	7.2	1.0	1.8
48	*26 Nov- 02 Dec	0.0	26.7	10.6	97	51	5.4	0.3	1.2
49	03 -09 Dec	0.0	26.8	12.8	96	54	4.2	0.6	1.2
50	10 - 16 Dec	0.0	24.6	8.6	94	44	5.4	0.5	1.2
51	17- 23 Dec	0.0	22.3	7.2	91	53	6.0	1.1	1.3
52	24 - 31 Dec	1.1	21.9	10.0	96	72	3.1	0.9	0.7
1	01 - 07 Jan	0.2	19.9	8.8	98	75	3.3	0.9	0.6
2	08 - 14 Jan	0.8	22.1	11.7	96	74	1.6	1.4	0.9
3	15 - 21 Jan	0.0	18.5	6.7	93	70	2.2	1.6	1.2
4	22 -28 Jan	7.0	20.0	9.8	94	68	3.4	3.1	1.7
5	29 Jan - 04 Feb	0.6	22.7	8.7	94	61	7.2	3.7	1.9
6	05 - 11 Feb	0.0	22.6	9.3	94	57	5.7	2.9	2.0
7	12 - 18 Feb	0.0	25.0	7.9	92	47	9.6	2.6	2.7
8	19 - 25 Feb	0.0	26.7	12.3	90	59	8.7	3.8	3.2
9	26 Feb – 04 Mar	0.1	28.6	12.5	95	53	8.4	1.8	2.9
10	05 - 11 Mar	0.0	29.7	13.5	89	54	9.1	2.4	3.5
11	12 - 18 Mar	0.0	32.9	16.6	89	53	8.9	2.4	4.1
12	19 - 25 Mar	0.0	36.5	19.3	85	49	8.7	2.3	4.6
13	26 Mar - 01Apr	0.0	38.0	18.6	79	39	9.4	3.1	5.9
14	02 - 08 Apr	0.0	40.2	18.1	76	31	9.7	2.6	6.5
15	09 - 15 Apr*	0.0	40.5	21.6	78	33	9.4	3.2	6.2

* Crop growing season

3.3.2 Temperature (°C)

Temperature is one of the most important meteorological variables influencing the germination, growth and development of a crop in a given agro-climatic condition. The mean weekly temperature of about 27.4 ºC was recorded at the time of sowing. The weekly mean maximum temperature varied from 18.5 to 40.5 ºC with an average of 27.4 ºC and the weekly mean minimum temperature varied from 6.7 to 21.6 ºC with an average of 12.2 ºC was recorded during the crop season of 2021-2022.

3.3.3 Relative humidity (%)

The weekly mean maximum relative humidity varied from 76 to 98 % with an average of 91 % and whereas the weekly mean minimum relative humidity varied from 31 to 75 % with an average of 54 % recorded during the *rabi* season of 2021-2022.

3.3.4 Sunshine duration (hours)

The length of bright sunshine hours during sowing was 6.5 hrs. Whereas, the weekly mean maximum and minimum sun-shine duration were 9.7 to 1.6 hrs. recorded during *rabi* 2021-22.

3.3.5 Evaporation (mm day^{-1})

The weekly mean evaporation during the crop growing period of *rabi* 2021-22 varied from 0.6 to 6.5 mm and with an average of 2.6 mm.

3.4 Soil analysis

The soil is a medium for plant growth and its properties influence growth, development and yield. Varanasi is located in the Indo-Gangetic alluvial plains having deep, well-drained soils. Experimental soil contained low organic carbon and available nitrogen however, the status of available phosphorus and potassium was medium. The texture of the experimental soil was sandy clay loam. Before the experiment, composite soil samples (0-15cm depth) were randomly collected from the various parts of the experimental field using a screw auger to make a composite sample. All precautions were taken for standard soil sampling. Thereafter the collected samples were air dried and crushed followed by the sieving through a 2 mm mesh sieve. The processed soil sample was analyzed for their mechanical composition, physical and chemical properties and the results are shown in Tables 3.2(a) and 3.2(b).

3.5 Cropping history

Previous crop history can be used to estimate the production potential of an experimental field. The study of cropping history in an experimentation field over time provides information about the general fertility status and crop production trend of the field. Table 3.3 shows the cropping history of the experiment field prior to experimentation.

3.6 Experimental details

3.6.1 Design and layout

The factorial experiment was set up in a randomized complete block design (RCBD) with three replications. The treatment consisted of four levels of nitrogen *i.e.* (50 kg ha^{-1}, 100 kg ha^{-1}, 150 kg ha^{-1}, 200 kg ha^{-1}) and three detasseling time *i.e.* No detasseling (control, D_1), detasseling at tassel emergence (D_2) and 7 days after tassel emergence (D_3). In this experiment, twelve treatment combinations were replicated thrice.

Table 3.2(a): Physical properties of the experimental soil

S. no	Particulars	Value	Method employed
Mechanical analysis			
Soil separates (%)			
1	Sand	49.72	Hydrometric method (Bouyoucos, 1962)
2	Silt	28.92	
3	Clay	19.52	
4	Textural class	Sandy clay loam	Textural triangle (Black, 1967)
	Taxonomy	Ustochrept	
Physical properties			
5	Bulk density (g cm^{-3})	1.34	Core sampler method (Piper, 1950)
6	Particle density (g cm^{-3})	2.64	Core sampler method (Piper, 1950)

Table 3.2(b): Chemical properties of experimental soil

S. no	Parameters	Value	Method employed
1	Organic carbon (%)	0.33	Walkley and Black rapid titration method (Jackson, 1973)
2	Soil pH	7.56	Glass electrode digital pH meter (Jackson, 1973)
3	Electrical Conductivity (dSm^{-1} at 25^oC)	0.4	Systronics electrical conductivity meter (Jackson, 1973)
4	Available nitrogen(kg ha^{-1})	198.13	Alkaline permanganate method (Subbiah and Asija,1956)
5	Available phosphorus (kg ha^{-1})	19.56	0.5 *M* $NaHCO_3$ extractable (Olsen *et al*., 1954)
6	Available potassium (kg ha^{-1})	147.28	Ammonium acetate extractable flamephotometer (Jackson, 1973)

The treatments were assigned to each replication and plots using randomization. Field border and block border effect, irrigation channel and plot border effect were all taken into account. Tables 3.4, 3.5 and 3.6 contain details about the experiment.

Table 3.3 Cropping history of experimental field

Year	**Season**	
	Rainy	**Winter**
2017-2018	Rice	Mustard
2018-2019	Rice	Mustard
2019-2020	Rice	Mustard
2020-2021	Rice	Baby corn
2021-2022	Rice	Experimental crop

Table 3.4 Details of treatment and abbreviations used

Treatments	Symbol used
Nitrogen levels (kg N ha^{-1})	
50	N_1
100	N_2
150	N_3
200	N_4
Detasseling Time	
No detasseling (Control)	D_1
At tassel emergence	D_2
7 days after tassel emergence	D_3

Table 3.5 Treatment combinations tested under experiment

Treatments no.	Treatments combination
T_1	N_1 D_1
T_2	N_1 D_2
T_3	N_1 D_3
T_4	N_2 D_1
T_5	N_2 D_2
T_6	N_2 D_3
T_7	N_3 D_1
T_8	N_3 D_2
T_9	N_3 D_3
T_{10}	N_4 D_1
T_{11}	N_4 D_2
T_{12}	N_4 D_3

Table 3.6 Details of layout plan

Design	Factorial experiment in Randomized Complete Block Design (RCBD)
Replication	3
Treatments	12
Total number of plots	12 × 3=36
Gross plot size	4.8 m × 3.3 m = 15.84 m^2
Net plot size	3.8 m × 2.3 m = 8.74 m^2
Plot border	0.3 m
Field border	1.5 m
Replication border	1.5 m
Main irrigation channel	1.5 m
Sub-irrigation channel	1.0 m
Crop	Baby corn
Spacing	40 × 20 cm
Seed rate	40 kg ha^{-1}
Variety	G-5414
Season	Winter
Sowing date	27^{th} November 2021
Fertilizer sources	Urea, DAP and MOP

3.7 Crop and Variety

The winter season baby corn was chosen as test crop for experimentation and grown using test variety G-5414 (Single cross hybrid). G-5414 is high yielding hybrid, has uniform-sized ears, long shelf-life, suitable for both fresh and processing for market purposes. This variety shows height of 180-200 cm, corn length 7.5-8.5 cm, corn diameter 1.3-1.5 cm, corn weight 7-8 g, light yellow, baby cob yield ranges from 75-100 q ha^{-1} while baby corn yield from 20-25 q ha^{-1}.

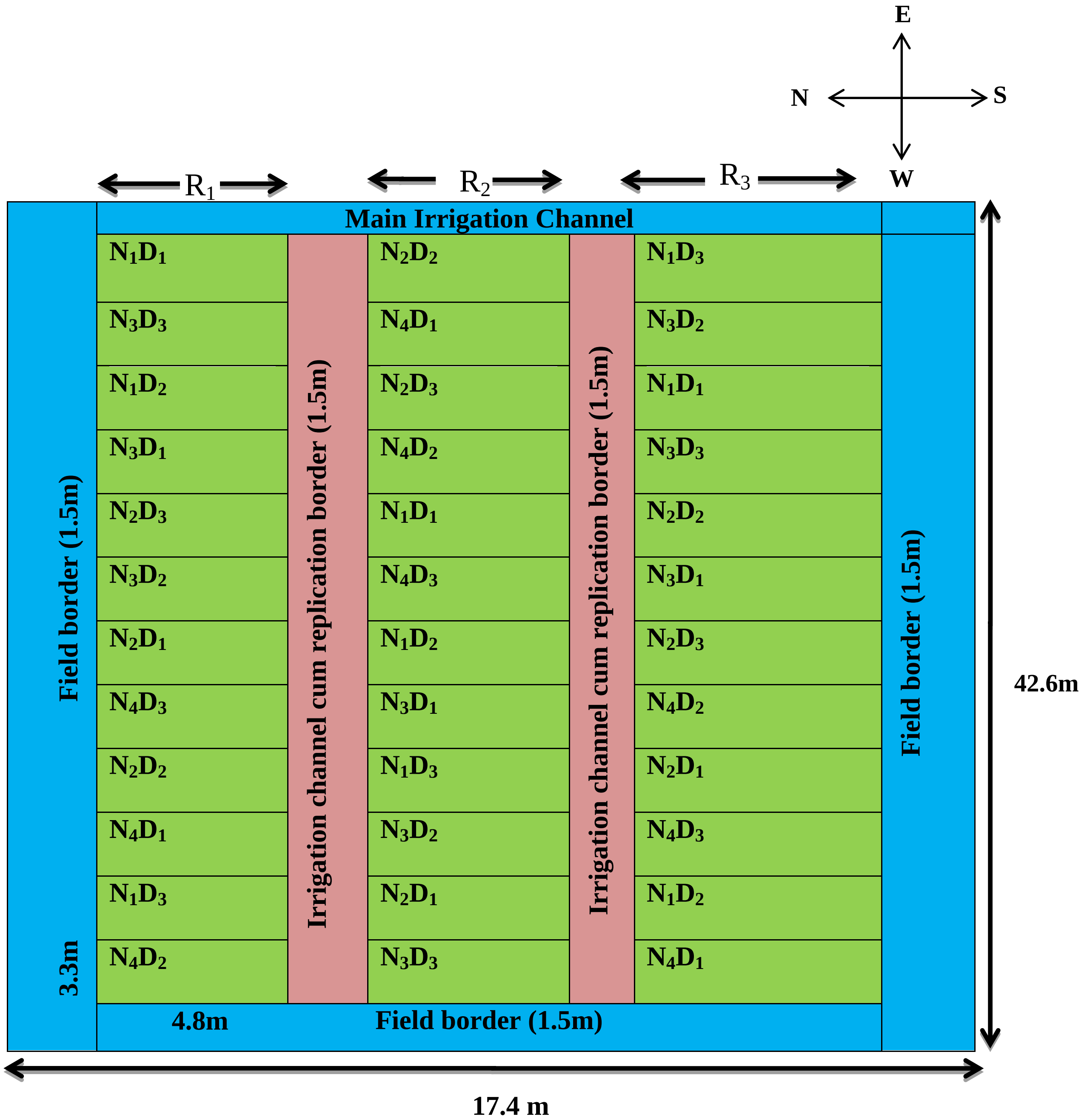


Fig 3.2: Layout plan of the experiment

3.8 Calendar of operation and cultural practices

Field operations performed during the experiment on baby corn and the cultivation practices followed are described below with a summary provided in Table 3.7.

3.8.1 Field Preparation

The first and most important requirement for maintaining optimal plant stand

and better crop establishment is proper field preparation. The field chosen for the experiment was prepared after harvesting the previous crop. First plouging was done with a tractor-drawn disc harrow, followed by a cultivator and harrowing with a rotavator and planking in a criss-cross pattern. The field was leveled uniformly. As a result, the layout was completed as per experimental design and predetermined plan.

3.8.2 Seed and sowing

Prior to sowing baby corn, the germination percentage and viability were tested in the lab by taking hundred seeds. Required seeds per plot were weighed adopting the seed rate of 40 kg ha^{-1} and the same were sown manually by opening the furrow at 40 × 20 cm spacing in rows at about 4-5 cm depth. Sowing was done on 27^{th} November 2021.

3.8.3 Fertilizer application

In this study, nitrogen, phosphorous, potassium, sulphur and zinc were supplied by urea, diammonium phosphate (DAP), muriate of potash (MOP), gypsum and zinc sulphate ($ZnSO_4$). The recommended nutrients *viz.* nitrogen was applied in three splits of 50, 25 and 25 as basal , at knee-height stage and at tassel emergence, respectively as per treatments and the entire dose of phosphorous, potassium, sulphur and zinc was (75 kg P_2O_5, 60 kg K_2O, 40 kg S and 10 kg Zn ha^{-1}) uniformly applied as basal application to all treatments.

The different sources of fertilizers used in the experiment were mentioned below along with their nutrient content in Table 3.7.

3.8.4 Gap filling and thinning

Extra plants were thinned to keep the plant population and crop stand optimal for better crop growth and to avoid competition. To maintain the optimum population, gaps were filled simultaneously by transplanting baby corn seedlings of the same physiological age.

Table 3.7 Sources of nutrients

Nutrient	Fertilizer Sources
Nitrogen	Urea (N-46%)
Phosphorus	DAP (P_2O_5-46% and N-18%)
Potassium	MOP (K_2O-60%)
Sulphur	Gypsum (S 18.6%)
Zinc	Zinc Sulphate ($ZnSo_4$) (35% Zn and 17.8% S)

3.8.5 Weed management

To control weeds effectively in the experimental field, spraying of post-emergence herbicide Topramezone (33.6 SC) @ 75 g *a.i.* ha $^{-1}$ combination with Atrazine (50 WP) @ 0.75 kg *a.i.* ha^{-1} were applied at 40 DAS.

3.8.6 Earthing up

Earthing up was done at 70 DAS which corresponded to a knee-high stage to check the crop lodging, provide aeration and prevent weeds for better crop growth.

3.8.7 Detasseling

Detasseling is an important recommended practice in baby corn cultivation and recommended to increase cob yield and quality and to avoid pollination and fertilization. Detasseling in this experiment was performed in all plots by hand as per treatment by holding the tassels and jerking them gently upward.

3.8.8 Irrigation

First irrigation was given after the complete emergence of baby corn seedlings to provide better moisture to crop. The irrigation was scheduled at most pronounced critical stages *viz*. seedling, knee-height stage, tasselling and silking stage to avoid the moisture stress during these stages.

3.8.9 Plant protection measures

During experimentation, application of Emamectine benzoate (5 SG) combination with Imidachlopride (17.8 SL) 100 ml ha^{-1} at 45 DAS to control stem borer (*Chilo partellus*).

Table 3.8 List of field operation

S.no.	Operation	Date
1.	Primary tillage	17.11.2021
2.	Layout of experiment	23.11.2021
3.	Seed sowing	27.11.2021
4.	Gap filling and thinning	19.12.2021
5.	Fertilizer application	
	a. Basal	27.11.2021
	b. 1^{st} split application (KHS)	04.02.2022
	c. 2^{nd} split application (TE)	03.03.2022
6.	Irrigation	
	a. First irrigation	13.12.2021
	b. Second irrigation	18.02.2022
	c. Third irrigation	09.03.2022
	d. Fourth irrigation	22.03.2022
	e. Fifth irrigation	01.04.2022
7.	Weeding (Herbicide application)	04.01.2022
8.	Insecticide application	08.01.2022
9.	Earthing up	04.02.22 to 15.02.22
10.	Detasseling	14.03.22 to 21.03.22
11.	Cob picking	21.03.22 to 08.04.22
12.	Harvesting (Fodder)	10.04.2022

3.8.10 Harvesting

Baby cobs were harvested from each net plot within two to three days of silk emergence. The weight of baby cobs (with husk) and baby corn (after husk removal) from each plot was recorded and expressed in kg ha^{-1}. Green fodder was harvested after the fourth picking (final picking) and the weight per plot was calculated in kg and expressed in t ha^{-1}.

3.9 Sampling procedure and observation

The sampling procedure is one of the most important steps in collecting data from the experimental field. In each experimental plot, five plants were chosen at random and tagged (Gomez and Gomez, 1976). These five plants were studied throughout the crop growth period to determine the relative response of all treatments on growth and yield attributes. Plant growth parameters were measured at 30, 60 and 90 days after sowing, as well as at harvest. However, three plant samples were collected from the second row after removing 50 cm from the border rows to record data on dry matter $plant^{-1}$.

3.10 Biometric observations

3.10.1 Growth characters

Observations on growth characters *viz*. plant population (initial), plant height (cm), green leaves $plant^{-1}$, chlorophyll content (SPAD value), dry matter accumulation (g) $plant^{-1}$ at 30, 60, 90 DAS and final at the time of harvest. LAI was recorded at 40, 60 and 90 DAS during the experimentation period.

3.10.1.1 Initial plant population ha^{-1}: After the completion of germination, the plants in each plot were counted and then converted into the number of plants ha^{-1} and presented as initial plant population.

3.10.1.2 Plant height (cm): The plant height was measured using the tagged plants from all experimental plots by a meter scale. The height was measured from the base of the plant up to the plant tip. The data collected at respective growth stages *i.e.* 30, 60, 90 DAS and at harvest. The mean height was presented in cm.

3.10.1.3 Number of green leaves plant^{-1}: At 30, 60, 90 DAS and at the harvest, the green leaves which were fully expanded their numbers counted from tagged plants of all experimental plots were counted, averaged and expressed as the number of green leaves plant^{-1}.

3.10.1.4 Leaf area index (LAI): Plant samples were collected from each plot at 40, 60 and 90 DAS and measured the leaf area by leaf area meter of three individual plants, averaged and calculated the leaf area index with the help of leaf area and ground area.

3.10.1.5 Dry matter accumulation plant^{-1} (g): Three plants were chosen randomly from the border (outer second row) of the each plot at respective growth stages (30, 60, 90 DAS and at harvest). Firstly samples drying done under shade for few days then were placed for oven drying at 70 °C for 48 hrs to get a constant weight. The resultant dry matter accumulation was recorded and presented as plant^{-1}(g).

3.10.1.6 Chlorophyll content (SPAD value): The diagnostic tool for determining chlorophyll is SPAD meter used widely to judge the crop nitrogen status. This simple tool for quickly and non-destructively estimating extractable chlorophyll in leaves and easy to carry since portable. To judge the SPAD value a SPAD meter was used. Measurement was performed from the center of fully expanded leaves of tagged plants from every plot at 30, 60, 90 DAS and at the time of harvest.

3.10.2 Yield attributes and yield

3.10.2.1 Final plant population ha^{-1}: The final plant population from each plot was recorded and converted to ha^{-1} at the time of cob harvest.

3.10.2.2 Barren plants ha^{-1}: Total number of plants and cob-bearing plants were counted from each net plot. The total number of plants was subtracted from the number of baby cob-bearing plants to obtain the number of barren plants plot^{-1}, which was then converted to the number of barren plants ha^{-1}.

3.10.2.3 Barrenness (%): Total number of plants and number of cob-bearing plants were counted from each net plot. The percentage of barren plants plot^{-1} was calculated by subtracting the number of baby corn-bearing plants from the total number of plants and finally converted into ha^{-1}.

3.10.2.4 Days to initiation of baby cob harvest: The tagged plants were used to calculate the number of days between sowing and harvesting the first baby cob (at the emergence of 2-3 cm long silk).

3.10.2.5 Days to 50% silk emergence: The number of days taken by half of the plant populations to reach 50% silk emergence was counted from the each plot in days and the same were recorded.

3.10.2.6 Period of harvest (days): The harvest period in days was determined by considering the entire harvest period. The harvesting began with the first picking of baby cob and end with the last picking (fourth).

3.10.2.7 Baby cobs plant^{-1}: The baby cobs harvested from each tagged plant of each plot were summed to know the total numbers and the values were compiled on average basis.

3.10.2.8 Baby corn length (cm): Five cobs chosen at random from each harvest and the husk was removed to determine their length and the mean length of dehusked corn was compiled.

3.10.2.9 Baby corn girth (cm): After measuring the baby corn length the same was used for determination of girth. Measurement of five baby corns done by Vernier Calipers to record the girth.

3.10.2.10 Baby cob weight (g): Five husked cobs were weighed and their average values were presented as baby cob weight (g).

3.10.2.11 Baby corn weight (g): Five baby corns were weighed and baby corn weight (g) was recorded as average values.

3.10.2.12 Baby cob: baby corn ratio: The weight of baby cob and baby corn from each plot was recorded. By dividing the values, the baby cob: baby corn ratio was calculated.

3.10.2.13 Baby cob yield (kg ha^{-1}): The weights of the baby cobs were noted plot wise up to fourth picking and the readings were added and converted into ha by multiplying by the conversion factor and expressed in kg ha^{-1}.

3.10.2.14 Baby corn yield (kg ha^{-1}): The yields of baby corn were recorded from each net plot till fourth picking and the values were added to know the total yield, multiplied by the conversion factor and expressed in kg ha^{-1}.

3.10.2.15 Fodder yield (t ha^{-1}): The green plants remaining after the final picking were harvested as stover from all net plots. Harvesting of fodder was done near the ground and recorded as green fodder yield and expressed in t ha^{-1}.

3.10.3 Quality parameters

3.10.3.1 Plant analysis: Treatment-specific samples of baby corn, husk and fodder were collected from each plot for chemical estimation of N, P and K. The samples were dried separately in a 70 ºC oven before being thoroughly ground in a Willey mill to pass through a 2 mm mesh sieve. For chemical analysis, samples were stored in a sealed and labeled container. The nutrient content of the above materials was estimated using the following methods:

3.10.3.2 Nitrogen Content (%): Using a modified Kjeldahl method, the nitrogen content of baby corn, husk and fodder was calculated (Jackson, 1973).

3.10.3.3 Phosphorus content (%): The phosphorus content of baby corn, husk and fodder was determined using Vandomolybdo phosphoric acid yellow color method and Barton's reagent (Jackson, 1973).

3.10.3.4 Potassium content (%): The potassium content of baby corn, cob husk and fodder was determined using a Flame Photometer after proper dilutions (Bhargava and Raghupati, 1993).

3.10.3.5 Protein content (%): The protein content of baby corn, husk and fodder the respective values were calculated by multiplying the nitrogen content by factor 6.25 (Humpshire, 1956).

3.10.3.6 Carbohydrate content (%): The Anthron method, as proposed by Hedge and Hofreiter (1962) was used to calculate the carbohydrate content of baby corn.

3.10.3.7 Sugar content (%): The sugar content of baby corn was determined using the method described by Dubois *et al.* (1956).

3.10.3.8 Starch content (%): The starch content of baby corn was determined using the Rapid method described by Knutson and Grove (1994).

3.10.3.9 Nutrient uptake (N, P and K) and protein harvest (kg ha^{-1}): The N, P, K and protein harvest (kg ha^{-1}) of baby corn, cob husk and green fodder were calculated by multiplying the dry yield of each with their respective nutrient content (%). Since, fresh baby corn and the green fodder contains lot of moisture thus, the fresh baby corn, cob husk and green fodder were converted into dry yield, and total nutrient uptake was calculated by adding them together.

3.11 Available soil nutrients (kg ha^{-1}): Soil samples were collected after crop harvest from each plot using standard method. The collected samples were processed using the method described earlier in this chapter under the heading 'Soil analysis' (S.no. 3.4). Processed samples were then placed in labeled and sealed polythene bags for chemical analysis. The available soil nutrients *viz.* nitrogen, phosphorous and potassium were determined by using standard methods as described in Table 3.2(b). of this chapter.

3.12 Economics:

The economics of different treatments were calculated separately by taking into account the current prices of inputs and output. The expanses done on fertilizers, payment of labor and miscellaneous (electricity, weeding etc., plant protection measures, irrigation and harvesting) were calculated for the experiment area and converted to hectare basis based on the prevalent rates at Research Farm. To calculate the cost of cultivation, all common and variable expenses incurred were included to calculate the total cost of each treatment and to calculate the net return ha^{-1} basis and benefit: cost ratio. The total income received from baby corn and green fodder was used to calculate the gross return. The cost of cultivation was considered while calculating the economics of treatments and was expressed as gross return (₹ ha^{-1}) and net return (₹ ha^{-1}).

3.12.1 Gross return (₹ ha^{-1}): The gross return was calculated by multiplying the total baby corn yield and green fodder yield by their respective prices and then added them together.

3.12.2 Net returns (₹ ha^{-1}): To calculate the net return following formula was used:

$$\text{Net return (₹ ha}^{-1}) = \text{Gross return (₹ ha}^{-1}) - \text{Cost of cultivation (₹ ha}^{-1})$$

3.12.3 Benefit: cost ratio

The benefit: cost ratio (B: C ratio) was calculated based on net return (₹ ha^{-1}) and cost of cultivation (₹ ha^{-1}).

$$\text{Benefit: cost ratio} = \frac{\text{Net returns (₹ ha}^{-1})}{\text{Cost of cultivation (₹ ha}^{-1})}$$

3.13 Statistical analysis

During the investigation, data on growth, yield attributes, yield, quality and economics were systematically tabulated and statistically analyzed for valid interpretations and conclusions. The appropriate 'Analysis of Variance' method for factorial randomized completely block design, as described by Gomez and Gomez (1984) was used. The significance of the treatments under study was determined using the variance ratio, also known as the 'F' test. Wherever the 'F' test was found to be significant, critical difference values (CD) at a 5% level using the formulae specified below:

C.D. at 5% = S.Em. ± × √2 × t value at 5% level of significance.

$$S.Em\pm = \sqrt{\text{Error mean sum of square}/r}$$

Table: 3.9 Analysis of Variance (ANOVA)

Source of variation	d. f.	S.S.	M.S.S	Cal. F Value	Tab. 'F' Value 5%
Replication (R)	2 (r-1)				3.44
Nitrogen levels (N)	3 (n-1)				3.05
Detasseling time (D)	2 (d-1)				3.44
N×D	6 (n-1)(d-1)				2.55
Error	22 (r-1)(nd-1)				
Total	35 (rnd-1)				

Where, R = replication, N = Nitrogen levels, D = Detasseling time, SS = Sum of Squares, d. f. = Degree of freedom, S.S. = Sum of Square, M.S.S = Mean Sum of Square, Cal. F value = calculated F value, Tab. F value = Tabulated F value.

Chapter IV

EXPERIMENTAL FINDINGS

The existing trial on "**Effect of nitrogen level and detasseling time on growth, yield and quality of winter baby corn (*Zea mays* L.)"** was accomplished at the Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during the winter season of the year 2021-22. Data related to growth attributes, yield and yield attributes, nutrient uptake and nutrient status of the experimental field as affected by different treatments applied to baby corn were recorded at their respective stages (30, 60, 90 DAS and at harvest). The Economics of baby corn has also been calculated. The data collected during the experimental period were statistically analyzed, and the results were summarised, systematically organized, and presented in tables, as well as depicted with graphs at appropriate places.

4.1 Growth attributes

4.1.1 Plant height (cm)

The plant height data was affected by various nitrogen levels and detasseling time at different growth stages (30, 60, 90 DAS and at harvest) have been arranged in Table 4.1.1 and Fig. 4 .1. It shows that plant height increased with the advancement of growth stages and reached to maximum at maturity, irrespective of experimental variables.

Detasseling time: Plant height showed non-significant variation at all growth stages (30, 60, 90 DAS and at harvest due to detasseling time *i.e.* D_1 (No detasseling), D_2 (At tassel emergence) and D_3 (7 days after tassel emergence).

Nitrogen levels: Plant height exhibited significant differences during different growth stages except for 30 DAS. At 30 DAS, highest plant height (21.79 cm) was recorded with the application of 150 kg N ha^{-1} (N_3) followed by N_4 (200 kg N ha^{-1}). The lowest plant height (21.11cm) was recorded with the application of treatment N_1 (50 kg N ha^{-1}) as compared to the N_2 (100 kg N ha^{-1}).

At 60 DAS, utmost plant height (63.42 cm) registered due to addition of nitrogen @ 200 kg ha^{-1} (N_4) closely followed by 150 kg N ha^{-1} (N_3) which also scored at par. The lowest plant height (55.96 cm) was recorded with N_1 (50 kg N ha^{-1}) as compared to the N_2 (100 kg N ha^{-1}) treatment..

The maximum plant height (121.30cm) recorded at 90 DAS with the application of treatment N_4 (200 kg N ha^{-1}) was statistically at par with N_3 (150 kg N ha^{-1}). The lowest plant height (103.94 cm) was recorded with the treatment of N_1 (50 kg N ha^{-1}) as compared to the N_2 (100 kg N ha^{-1}).

At harvest, significantly maximum plant height (202.17 cm) was recorded with the treatment of N_4 (200 kg N ha^{-1}) over N_1 and N_2 but was statistically at par with N_3 (197.61 cm). The lowest plant height (171.22 cm) recorded with N_1 (50 kg N ha^{-1}) than the N_2 treatment (100 kg N ha^{-1}).

Interaction effect due to the nitrogen levels and detasseling time was found non-significant at all growth stages of the crop during experimentation.

4.1.2 Number of leaves plant^{-1}

The number of leaves plant^{-1} affected by various levels of nitrogen and detasseling time at different growth stages (30, 60, 90 DAS and at harvest) have been presented in Table 4.1.2 and Fig. 4.2. The number of leaves plant^{-1} increased with the growth stages and maximum values observed at harvest stage.

Detasseling time: Number of leaves plant^{-1} was observed non-significant at all the growth stages (30, 60, 90 DAS and at harvest) with the treatments of D_1 (No detasseling), D_2 (At tassel emergence) and D_3 (7 days after tassel emergence).

Nitrogen levels: The data relating to the number of leaves plant^{-1} due to different levels of nitrogen have been shown statistically significant at all growth stages except 30 DAS.

At 30 DAS, maximum number of leaves plant^{-1} (5.04) was observed with the application of treatment N_4 (200 kg N ha^{-1}) followed by N_3 (150 kg N ha^{-1}) which showed non-significant differences among them. The lowest number of leaves plant^{-1} (4.91) was observed with N_1 (50 kg N ha^{-1}) when compared with N_2 (100 kg N ha^{-1}) treatment.

At 60 DAS, significantly maximum number of leaves plant^{-1} (10.20) was recorded with N_4 (200 kg N ha^{-1}) superior over the N_1 & N_2 but observed at par with N_3 (150 kg N ha^{-1}). The minimum number of leaves plant^{-1} (9.74) recorded with the treatment N_1 (50 kg N ha^{-1}) followed by N_2 (100 kg N ha^{-1}).

Significantly highest number of leaves plant^{-1} (11.44) recorded at 90 DAS with treatment N_4 (200 kg N ha^{-1}) found superior over N_1 & N_2 but statistically at par with N_3 (150 kg N ha^{-1}). The lowest number of green leaves plant^{-1} (10.20) was recorded with N_1 (50 kg N ha^{-1}) when compared with N_2 (100 kg N ha^{-1}).

At harvest, significantly highest number of leaves plant $^{-1}$ (14.67) were recorded with the treatment N_4 (200 kg N ha^{-1}) which was superior over N_1 & N_2 but statistically at par with N_3 (200 kg N ha^{-1}). N_1 (50 kg N ha^{-1}) treatment which claimed the lowest number of leaves plant^{-1} (13.50) than N_2 (100 kg N ha^{-1}).

The interaction effect between the nitrogen levels and detasseling time on the number of leaves plant^{-1} was found non-significant at all growth stages during experimentation.

4.1.3 Dry matter accumulation plant^{-1} (g)

Dry matter accumulation plant^{-1} recorded at different growth stages of baby corn (30, 60, 90 DAS and at harvest) are presented in Table 4.1.3 and Fig. 4.3.

Detasseling time: Dry matter accumulation plant^{-1} could not affected significantly due to detasseling time in all growth stages (30, 60, 90 DAS and at harvest) due to the treatments D_1 (No detasseling), D_2 (At tassel emergence) and D_3 (7 days after tassel emergence).

Nitrogen levels: Dry matter accumulation plant^{-1} was recorded significant variation due to various nitrogen levels at all growth stages except 30 DAS.

At 30 DAS, application of treatment N_4 (200 kg N ha^{-1}) resulted in maximum dry matter accumulation plant^{-1} (0.32 g plant^{-1}) but the differences were found non-significant.

At 60 DAS, significantly maximum dry matter accumulation plant^{-1} (4.52 g plant^{-1}) was recorded with the treatment N_4 (200 kg N ha^{-1}) which was superior over the N_1& N_2 but statistically at par with N_3 (150 kg N ha^{-1}). The minimum dry matter accumulation plant^{-1} (3.87 g plant^{-1}) was observed with N_1 (50 kg N ha^{-1}) when compared to N_2 (100 kg N ha^{-1}).

At 90 DAS, significantly highest dry matter accumulation plant^{-1} (24.57 g plant^{-1}) was observed with treatment N_4 (200 kg N ha^{-1}) which was superior over N_1 & N_2 but noted at par with N_3 (150 kg N ha^{-1}) treatment. The lowest dry matter accumulation plant^{-1} (17.47 g plant^{-1}) was recorded with treatment N_1 (50 kg N ha^{-1}) when compared to N_2 (100 kg N ha^{-1}).

At harvest, significantly largest dry matter accumulation plant^{-1} registered due to treatment N_4 (200 kg N ha^{-1}) found superior over N_1 & N_2 but statistically at par with N_3. The minimum dry matter accumulation plant^{-1} (44.01 g plant^{-1}) was recorded with treatment N_1 when compared to N_2

The interaction effect between the nitrogen levels and detasseling time on dry matter accumulation plant^{-1} did not show any significant difference at all growth stages.

4.1.4 Leaf area index (LAI)

Data related to leaf area index recorded at 40, 60 and 90 DAS and presented in Table 4.1.4 and Fig. 4.4.

Detasseling time: The effect of detasseling time on LAI failed to show any significant difference at all growth stages (40, 60 and 90 DAS) with treatments D_1 (No detasseling), D_2 (At tassel emergence) and D_3 (7 days after tassel emergence).

Nitrogen levels: Leaf area index significantly differed due to nitrogen levels at various growth stages (40, 60 and 90 DAS) of baby corn.

At 40 DAS, the highest leaf area index (0.22) was noted with the application of treatment N_4 (200 kg N ha^{-1}) which was superior over N_1 & N_2 though found at par with N_3 (150 kg N ha^{-1}). N_1 (50 kg N ha^{-1}) treatment which showed lowest LAI (0.19) statistically comparable to N_2 (100 kg N ha^{-1}) treatment.

At 60 DAS, the maximum LAI (1.23) recorded with the application of treatment N_4 (200 kg N ha^{-1}) proved superior over the treatment N_1 & N_2 but found at par with N_3 (150 kg N ha^{-1}). The minimum leaf area index (1.08) was noted with the treatment N_1 (50 kg N ha^{-1}) compared with N_2 (100 kg N ha^{-1}) treatment.

At 90 DAS, application of treatment N_4 (200 kg N ha^{-1}) showed highest leaf area index (3.91) which was statistically superior over the treatment of N_1 & N_2 but at par results were observed with treatment N_3 (150 kg N ha^{-1}). The lowest leaf area index (2.18) was recorded with the treatment N_1 (50 kg N ha^{-1}) compared with N_2 (100 kg N ha^{-1}) treatment.

The interaction effect between the nitrogen levels and detasseling time on LAI failed to show any significant difference at all growth stages during experimentation.

4.1.5 Chlorophyll content (SPAD value)

The chlorophyll content (SPAD value) of baby corn plant leaves was recorded at various growth stages (30, 60, 90 and at harvest) an is presented in Table 4.1.5. and Fig. 4.5.

Detasseling time: The effect of detasseling time on chlorophyll content failed to show any significant difference at all growth stages (30, 60, 90 DAS and at harvest) with the treatments D_1 (No detasseling), D_2 (At tassel emergence) and D_3 (7 days after tassel emergence).

Nitrogen levels: Data recorded on chlorophyll content of baby corn leaves showed significant variations due to nitrogen levels.

At 30 DAS, applicaton of treatment N_3 (150 kg N ha^{-1}) recorded significantly highest SPAD value (31.87) followed by N_2 (100 kg N ha^{-1}) & N_4 (200 kg N ha^{-1}). The lowest SPAD value (29.84) was recorded with treatment N_1 (50 kg N ha^{-1}) which was statistically at par with N_2 (100 kg N ha^{-1}).

At 60 DAS, application of treatment N_4 (200 kg N ha^{-1}) registered maximum SPAD value (33.27) which was significantly superior than N_1 & N_2 but statistically at par with N_3 (150 kg N ha^{-1}). The minimum SPAD value (31.60) was recorded with N_1 (50 kg N ha^{-1}) compared to N_2 (100 kg N ha^{-1}).

At 90 DAS, significantly highest SPAD value (43.74) was recorded with the application of treatment N_4 (200 kg N ha^{-1}) higher than N_1 & N_2 but found statistically at par with N_3 (150 kg N ha^{-1}). The lowest SPAD value (30.38) was recorded with treatment N_1 (50 kg N ha^{-1}) compared to N_2 (100 kg N ha^{-1}) treatment.

At harvest, significantly maximum SPAD value (49.13) was noted with treatment N_4 (200 kg N ha^{-1}) which was statistically superior over the N1, N_2 and N_3. The lowest SPAD value (29.93) was recorded with application of treatment N_1 (50 kg N ha^{-1}) when compared to N_2 (100 kg N ha^{-1}).

The interaction effect between the nitrogen levels and detasseling time on chlorophyll content did not show any significant variation at all growth stages during experimentation.

4.1.6 Initial plant population (No's ha^{-1})

The initial plant population (ha^{-1}) as affected because of nitrogen levels and detasseling time have been presented in Table 4.1.6 and Fig. 4.6.

Detasseling time: Initial plant stand ha^{-1} could not show any significant difference due to the detasseling time treatments.

Nitrogen levels: The initial plants stand ha^{-1} observed non-significant effect due to the various nitrogen level treatments.

The interaction effect between the nitrogen levels and detasseling time on initial plants stand ha^{-1} failed to show statistical difference among the various treatments.

4.2 Yield attributes

4.2.1 Final plant stands (No's ha^{-1})

The final plant population ha^{-1} as affected due to nitrogen levels and detasseling time on baby corn have been presented in Table 4.1.6 and Fig.4.6.

Detasseling time: The effect of detasseling time on final plant population ha^{-1} failed to show any significant difference among the various treatments.

Nitrogen levels: Statistical analysis revealed that the effect of nitrogen levels on final plant population ha^{-1} did not show any significant difference during experimentation.

The interaction effect between the nitrogen levels and detasseling time on final plant population ha^{-1} did not show any significant difference during investigation.

4.2.2 Barren plants (ha^{-1}) and barrenness (%)

The data related to barren plants (ha^{-1}) and barrenness (%) as affected due to nitrogen levels and detasseling time have been presented in Table 4.1.6 and Fig. 4.7.

Detasseling time: Barren plants (ha^{-1}) and barrenness (%) showed non-significant variation due to the effect of detasseling time treatments.

Nitrogen levels: The effect of different nitrogen levels on barren plants (ha^{-1}) and barrenness (%) did not show any significant variation due to various treatments.

The interaction effect between the nitrogen levels and detasseling time on barren plants (ha^{-1}) and barrenness (%) failed to show any significant difference due to various treatments.

4.2.3 Days to initiation of baby cob harvest

Data regarding days to initiation of baby cob harvest as affected by nitrogen levels and detasseling time treatments of baby corn presented in Table 4.1.7 and Fig. 4.8.

Detasseling time: The effect of detasseling time on days to initiation of baby cob harvest could not show any significant effect with the treatments of D_1 (No detasseling), D_2 (At tassel emergence) and D_3 (7 days after tassel emergence).

Nitrogen levels: Days to initiation of baby cob harvest as affected due to various nitrogen levels showed significant variation during experimentation. Application of treatment N_1 (50 Kg N ha^{-1}) showed more number of days to initiation of baby cob harvest (118.00) which was superior over the treatments N_3 & N_4 but found statistically at par with N_2 (100 kg N ha^{-1}) treatment. Adding N_4 (200 kg N ha^{-1}) treatment took the lowest number of days to initiation of baby cob for harvest (115.11) which was statistically at par with N_3 (150 kg N ha^{-1}).

The interaction effect between the nitrogen levels and detasseling time on days to initiation of baby cob harvest did not show any significant effect due to various treatments.

4.2.4 Days to 50% silk emergence

The data related to days to 50% silk emergence as affected by various nitrogen levels and detasseling time have been presented in Table 4.1.7 and Fig.4.8.

Detasseling time: Effect of detasseling time on days to reach 50% silk emergence failed to show any significant effect with the treatments D_1 (No detasseling), D_2 (At tassel emergence) and D_3 (7 days after tassel emergence).

Nitrogen levels: The number of days to reach 50% silk emergence is significantly influenced by various nitrogen levels. Application of treatment N_1 (50 kg N ha^{-1}) showed significantly more number of days to reach 50% silk emergence (120.17) which was superior over with treatments N_3 & N_4 but statistically at par with N_2 (100 kg N ha^{-1}) treatment. The lowest number of days (116.56) was observed with treatment N_4 (200 kg N ha^{-1}) which was statistically at par with treatment N_3 (150 kg N ha^{-1}).

Interaction effect between the nitrogen levels and detasseling time on days to reach 50% silk emergence was recorded non-significant variation during experimentation.

4.2.5 Period of harvest (days)

The data recorded during investigation related to the period of harvest (days) for winter baby corn as affected by various nitrogen levels and detasseling time have been presented in Table 4.1.8 and Fig. 4.9.

Detasseling time: The effect of detasseling time on the period of harvest (days) showed a significant variation due to various treatments. A significantly more number of days taken to harvest the baby corn (17.50) was observed with treatment D_2 (At tassel emergence) compared with D_1 (No detasseling), but at par results observed with D_3 (7 days after tassel emergence) treatment. The lowest number of days taken for baby corn harvest (16.75) was observed with D_1 (No detasseling) compared with other treatments.

Nitrogen levels: The effect of various nitrogen levels on the period of harvest (days) showed significant variation due to various treatments. Significantly maximum number of days taken to harvest the baby corn (19.78) as recorded with treatment N_4 (200 kg N ha^{-1}) which was superior to N_1 & N_2 but was found at par with N_3 (150 kg N ha^{-1}). However, the lowest number of days taken to harvest the baby corn (13.56) was recorded with the application of treatment N_1 (50 kg N ha^{-1}) compared to N_2 (100 kg N ha^{-1}) treatment.

The interaction effect between the nitrogen levels and detasseling time on the period of harvest (days) showed non-significant variation during experimentation

4.2.6 Baby cobs plant^{-1} (no's)

The data regarding the number of baby cobs plant^{-1} as affected by various nitrogen levels and detasseling time have been presented in Table 4.1.8 and Fig. 4.9.

Detasseling time: Baby cobs plant^{-1} showed significant variation due to detasseling time treatments. Significantly more number of baby cobs plant^{-1} (3.68) was recorded with the application of treatment D_2 (At tassel emergence) which was superior over the treatment D_1 (No detasseling) but observed statistically at par with D_3 (7 days after tassel emergence). The lowest number of baby cobs plant^{-1} (3.50) was recorded with treatment D_1 (No detasseling).

Nitrogen levels: The number of baby cobs plant^{-1} showed significant variation due to various nitrogen levels. Application of treatment N_4 (200 kg N ha^{-1}) observed more number of baby cobs plant^{-1} (3.97) which was superior over the N_1 & N_2 but it was found at par with N_3 (150 kg N ha^{-1}) treatment. Application of treatment N_1 (50 kg N ha^{-1}) resulted in the lowest number of baby cobs plant^{-1} (3.03) when compared to N_2 (100 Kg N ha^{-1}).

The interaction effect between the nitrogen levels and detasseling time on the number of baby cobs plant^{-1} could not show any significant variation during experimentation.

4.2.7 Baby corn length (cm)

The data pertaining to baby corn length showed significant variation due to various nitrogen levels and detasseling time have presented in Table 4.1.9 and Fig.4.10.

Detasseling time: Different treatments regarding detasseling time significantly influenced the length of baby corn. The maximum baby corn length (10.44 cm) was recorded with the application of treatment D_2 (at tassel emergence) followed by D_3 (7 days after tassel emergence) which showed at par results with D_1 (No detasseling). The lowest baby corn length (9.34 cm) was recorded with D_1 (No detasseling).

Nitrogen levels: Significant difference in baby corn length was observed due to various nitrogen levels. Significantly highest baby corn length (10.48 cm) recorded with treatment N_4 (200 kg N ha^{-1}) which was superior over the treatment N_1 & N_2 but was noted at par with N_3 (150 kg N ha^{-1}). Application of treatment N_1 (50 kg N ha^{-1})

caused lowest baby corn length (9.19 cm) when compared to N_2 (100 kg N ha^{-1}) treatment.

The interaction effect between the nitrogen levels and detasseling time on baby corn length could not showed any significant variation due to the various treatments.

4.2.8 Baby corn girth (cm)

The data regarding baby corn girth as affected due to various nitrogen levels and detasseling time have been presented in Table 4.1.9 and illustrated in Fig. 4.10.

Detasseling time: Analyzed data showed that detasseling time significantly affected the baby corn girth due to various treatments. Application of treatment D_2 (at tassel emergence) resulted in significantly higher baby corn girth (1.35 cm) over the D_1 (No detasseling) but at par with D_3 (7 days after tassel emergence) treatment. The lowest baby corn girth (1.29 cm) was observed with treatment D_1 (No detasseling) compared to other treatments.

Nitrogen levels: Baby corn girth varied significantly with nitrogen levels. Significantly highest baby corn girth (1.41) was recorded with treatment N_4 (200 kg N ha^{-1}) over the N_1, N_2 and N_3. Application of treatment N_1 (50 kg N ha^{-1}) resulted in the lowest baby corn girth (1.25 cm) when compared with N_2 (100 kg N ha^{-1}) treatment.

Interaction effect of baby corn girth due to various nitrogen levels and detasseling time could not resulted any difference durig experimental period.

4.2.9 Baby cob weight (g)

The data presented in Table 4.1.10 and illustrated in Fig 4.11 on baby cob weight showed significant variation due to various nitrogen levels and detasseling time treatments.

Detasseling time: Significant variation showed in baby cob weight due to various detasseling time treatments. The maximum baby cob weight (39.43 g) registered with treatment D_2 (at tassel emergence) was greater than D_1 (No detasseling) and D_3 (7 days after tassel emergence). Application of treatment D_1 (No detasseling) resulted in the lowest baby cob weight (36.87 g) when compared with D_3 (7 days after tassel emergence).

Nitrogen levels: Different treatments of nitrogen levels significantly influenced the baby cob weight. Significantly highest baby cob weight (41.39 g) was recorded with treatment N_4 (200 kg N ha^{-1}) which proved superior over the treatments N_1, N_2 and $N_{3.}$ The lowest baby cob weight (34.85) was recorded with treatment N_1 (50 kg N ha^{-1}) when compared to N_2 (100 kg N ha^{-1}) treatment.

The interaction effect between the nitrogen levels and detasseling time on baby cob weight could not reach significant levels due to various treatments.

4.2.10 Baby corn weight (g)

Baby corn weight influenced due to various nitrogen levels and detasseling time has been presented in Table 4.1.10 and depicted in Fig. 4.11.

Detasseling time: The effect of detasseling time significantly influenced the baby corn weight due to various treatments. Significantly highest baby corn weight (8.89 g) was observed with treatment D_2 (At tassel emergence) followed by D_3 (7 days after tassel emergence) and D_1 (No detasseling). The lowest baby corn weight (7.97 g) was observed with treatment D_1 (No detasseling) when compared with D_3 (7 days after tassel emergence).

Nitrogen levels: Baby corn weight was significantly influenced by nitrogen levels. Maximum baby corn weight (9.20 g) was observed with the application of treatment N_4 (200 kg N ha^{-1}) which was significantly greater than N_1 and N_2, though statistically at par with N_3 (150 kg N ha^{-1}). Execution of N_1 (50 kg N ha^{-1}) produced minimum weight of baby corn (7.60 g) noted equal to N_2 (100 kg N ha^{-1}).

The interaction effect between the nitrogen levels and detasseling time on baby corn weight showed a non-significant variation during course of invetsigation.

4.2.11 Baby cob: baby corn ratio

The data pertaining to baby cob: baby corn ratio as affected by various nitrogen levels and detasseling time have been presented in Table 4.1.10 and Fig. 4.11.

Different treatments of nitrogen levels and detasseling time could not influence the baby cob: baby corn ratio which was found non-significant during experimentation.

4.2.12 Baby cob yield (kg ha^{-1})

The data presented in Table 4.1.11 and illustrated in Fig 4.12 on baby cob yield is significantly affected by various nitrogen levels and detasseling time.

Detasseling time: Different treatments of detasseling time significantly influenced the baby cob yield. Significantly highest baby cob yield (9040.33 kg ha^{-1}) registered with treatment D_2 (at tassel emergence) which was superior than the treatment D_1 (No detasseling) but it was found at par with D_3 (7 days after tassel emergence). The lowest baby cob yield (8011.75 kg ha^{-1}) was recorded with treatment D_1 (No detasseling) when compared to D_3 (7 days after tassel emergence). The increasing order of baby cob yield with detasseling time is $D_1<D_3<D_2$.

Nitrogen levels: Various levels of nitrogen have significantly influenced the baby cob yield due to different treatments. Maximum baby cob yield (10267.00 kg ha^{-1}) was recorded with treatment N_4 (200 kg N ha^{-1}) which was superior over treatment N_1 and N_2, but statistically equal to N_3 (150 kg N ha^{-1}). Execution of N_1 (50 kg N ha^{-1}) resulted in the lowest baby cob yield (6480.89 kg ha^{-1}) when it was compared with N_2 (100 kg N ha^{-1}) treatment. The decreasing order of the baby cob yield with nitrogen levels was $N_4>N_3>N_2>N_1$

The interaction effect between the nitrogen levels and detasseling time on baby cob yield did not show any significant variation due to various treatments.

4.2.13 Baby corn yield (kg ha^{-1})

The data concerning baby corn yield as significantly influenced by various nitrogen levels and detasseling time have been present in Table 4.1.11 and Fig. 4.12.

Detasseling time: Various detasseling time treatments significantly influence the baby corn yield. The treatment D_2 (at tassel emergence) accounted maximum yield of baby corn (2046.03 kg ha^{-1}) compared to D_1 (No detasseling) but found at par with D_3 (7 days after tassel emergence). Application of treatment D_1 (No detasseling) registered the lowest baby corn yield (1736.33 kg ha^{-1}) which was compared with D_3 (7 days after tassel emergence). The decreasing order of baby corn yield with detasseling time is D_2>D_3>D_1.

Nitrogen levels: Baby corn yields were significantly influenced by different nitrogen levels. Application of treatment N_4 (200 kg N ha^{-1}) significantly recorded the highest baby corn yield (2287.09 kg ha^{-1}) which was statistically superior over the treatments N_1 and N_2. However, treatment N_3 (150 kg N ha^{-1}) was observed at par to N_4. The lowest baby corn yield (1416.23 kg ha^{-1}) was recorded with treatment N_1 (50 kg N ha^{-1}) when compared to N_2 (100 kg N ha^{-1}). The increasing order of baby corn yield with nitrogen levels was N_1< N_2<N_3<N_4.

The interaction effect between the nitrogen levels and detasseling time on baby corn yield could not show any significant variation during experimentation.

4.2.14 Fodder yield (t ha^{-1})

The data showed that the fodder yield of baby corn as influenced by nitrogen levels and detasseling time have been presented in Table 4.1.11 and Fig. 4.12.

Detasseling time: The effect of detasseling time treatments on fodder yield failed to show a significant variation which was found non-significant variation during experimental period.

Nitrogen levels: Fodder yield of baby corn is significantly influenced due to various nitrogen levels. Analyzed data indicated that maximum fodder yield (27.71 t ha^{-1}) was recorded with treatment N_4 (200 kg N ha^{-1}) which was statistically superior over the

N_1 and N_2. However, statistically at par results were observed with N_3 (150 kg N ha^{-1}) treatment. The lowest baby corn fodder yield (18.56 t ha^{-1}) was registered with treatment N_1 (50 kg N ha^{-1}) which was statistically at par with treatment N_2 (100 kg N ha^{-1}). The trend was in order of $N_4 > N_3 > N_2 > N_1$ as affected by various nitrogen levels.

The interaction effect between the nitrogen levels and detasseling time on fodder yield showed a non-significant variation due to various treatments.

4.2.15 Picking wise baby cob yield (kg ha^{-1})

The data gathered on picking wise yield of baby cob as influenced due to various nitrogen levels and detasseling time treatments have been showed in Table 4.1.12 and illustrated in Fig. 4.13.

Detasseling time: The data related to the detasseling time treatments significantly influenced the picking wise baby cob yield. The highest picking wise baby cob yield was recorded with treatments D_2 (At tassel emergence) followed by D_3 (7 days after tassel emergence) and D_1 (No detasseling). The II^{nd} picking recorded the highest baby cob yield followed by I^{st}, III^{rd} and IV^{th} picking. Application of treatment D_2 (at tassel emergence) resulted in significantly highest baby cob yield in I^{st} picking which was superior over the treatment D_1 (No detasseling), though statistically at par with treatment D_3 (7 days after tassel emergence). Similar trend has been observed in II^{nd}, III^{rd} and IV^{th} picking. The baby cob yield increased up to II^{nd} picking, then after it gradually decreased in III^{rd} and IV^{th} pickings. The effect of detasseling time found in order of picking wise baby cob yield $II^{nd} > I^{st} > III^{rd} > IV^{th}$ picking.

Nitrogen levels: Various nitrogen levels investigated under the experiment showed significant variation in picking wise baby cob yield. The highest baby cob yield was recorded in II^{nd} picking followed by I^{st}, III^{rd} and IV^{th} picking. Application of treatment N_4 (200 kg N ha^{-1}) significantly showed the maximum baby cob yield in all four pickings which was superior over the treatments N_1 and N_2, but the application of treatment N_3 (150 kg N ha^{-1}) found at par results in all four pickings. I^{st} picking of bay cob found significantly highest cob yield with the application of treatment N_4 (200 kg N ha^{-1}) followed by N_3, N_2 and N_1. Similar trend had been followed in II^{nd}, III^{rd} and

IV^{th} picking. The baby cob yield increased up to II^{nd} picking, then after it gradually decreases in III^{rd} and IV^{th} picking. Thus the decreasing order of baby cob yield in picking wise is II^{nd}> I^{st}> III^{rd}> IV^{th} picking.

The interaction effect between the various nitrogen levels and detasseling time on picking wise baby cob yield failed to show any significant variation due to various treatments during experimentation..

4.2.16 Picking wise baby corn yield (kg ha^{-1})

The data presented in Table 4.1.13 and depicted in Fig.4.14 related to picking wise baby corn yield revealed that significant variation showed due to various nitrogen levels and detasseling time treatments.

Detasseling time: The treatments regarding detasseling time resulted significant influence on picking wise baby corn yield. Analyzed data clearly showed that application of treatment D_2 (at tassel emergence) produced significantly highest baby corn yield in all four pickings which was superior over the treatment D_1 (No detasseling), but statistically at par with D_3 (7 days after tassel emergence). The highest baby corn yield was recorded in II^{nd} picking followed by I^{st}, III^{rd} and IV^{th} picking. Application of treatment D_2 (At tassel emergence) showed significantly highest I^{st} picking baby corn yield followed by D_3 (7 days after tassel emergence) and D_1 (No detasseling). Similar trend has been followed in II^{nd}, III^{rd}, and IV^{th} pickings. The baby corn yield increased up to II^{nd} picking then gradually decreased in III^{rd} and IV^{th} picking.

Nitrogen levels: Significant variation exhibited on picking wise baby corn yield due to various nitrogen levels. The data indicated that treatment N_4 (200 kg N ha^{-1}) found significantly highest baby corn yields in all four pickings which were superior over the treatments N_1 and N_2. Application of treatment N_3 (150 kg N ha^{-1}) provided statistically at par results. The highest baby corn yield is found in II^{nd} picking followed by I^{st}, III^{rd} and IV^{th} picking which increases with increasing nitrogen levels. Application of treatment N_4 (200 kg N ha^{-1}) was significantly highest in I^{st} picking baby corn yield followed by N_3, N_2 and N_1. Similar trend has been found in II^{nd}, III^{rd}, and IVth picking. The picking wise baby corn yield increased up to IInd picking then gradually decreased in IIIrd and IVth picking. The decreasing order in baby corn yield is IInd>Ist> IIIrd> IVth picking.

The interaction effect due to various nitrogen levels and detasseling time treatments on picking wise baby corn yield did not find any significant variation due to various treatments.

4.3 Quality Parameters

4.3.1 Nitrogen (%) in baby corn, cob husk and fodder

The data corresponding to N content (%) in the fodder, husk and baby corn as affected by the factors (nitrogen levels and detasseling time) under study have been arranged in Table 4.1.14 Fig. 4.15.

Detasseling time: Analyzed data indicate that detasseling time significantly influence the nitrogen content (%) of baby corn, cob husk and fodder. Application of treatment D_2 (at tassel emergence) was significantly highest N content (%) of baby corn, cob husk and fodder superior over the treatments D_1 (No detasseling), but statistically at par with D_3 (7 days after tassel emergence). Similarly, the lowest N content (%) was recorded with treatment D_1 (No detasseling) when compared to D_3 (7 days after tassel emergence) during the experimentation.

Nitrogen levels: Different levels of nitrogen treatments significantly influenced the N content (%) of baby corn, cob husk and fodder. The data showed that significantly highest N content (%) of baby corn, cob husk and fodder improved with the treatment N_4 (200 kg N ha^{-1}) over the treatments N_1 and N_2, but statistically at par with treatment N_3 (150 kg N ha^{-1}). However, the lowest N content (%) of baby corn, cob husk and fodder was recorded with treatment N_1 (50 kg N ha^{-1}) compared to treatment N_2 (100 kg N ha^{-1}). Nitrogen content (%) of baby corn, cob husk and fodder values increased with an increase in the nitrogen levels.

Interaction between the nitrogen levels and detasseling time failed to show the significance due to various treatment levels during experimentation.

4.3.2 Phosphorous content (%) of baby corn, cob husk and fodder

The data pertaining to the phosphorous content (%) of baby corn, cob husk and fodder as varied due to various nitrogen levels and detasseling time have been presented in Table 4.1.15 and depicted in Fig. 4.17.

Detasseling time: Phosphorous content of bay corn, cob husk and fodder has been significantly influenced by various detasseling time treatments. Significantly highest phosphorous content was recorded with treatment D_2 (at tassel emergence) when compared with D_1 (No detasseling), but it was found statistically at par with D_3 (7 days after tassel emergence). Application of treatment D_1 (No detasseling) accounted lowest P content (%) compared to treatment D_3 (7 days after tassel emergence).

Nitrogen levels: Experimentation related to various nitrogen levels showed a significant variation in phosphorous (%) of baby corn, cob husk and fodder. Phosphorous content (%) of baby corn, cob husk and fodder recorded was significantly highest with treatment N_4 (200 kg N ha^{-1}) compared with N_1 and N_2. However, N_3 (150 kg N ha^{-1}) showed at par results. Similarly, the lowest phosphorous content (%) of baby corn, cob husk and fodder was recorded with treatment N_1 (50 kg N ha^{-1}) when compared with N_2 (100 kg N ha^{-1}).

Phosphorous content (%) of baby corn, cob husk and fodder could not reach significant levels due to various treatments during the experimentation.

4.3.3 Potassium content (%) of baby corn, cob husk and fodder

The data gathered regarding effect of N levels and detasseling time on potassium content of baby corn, cob husk and fodder have been presented in Table 4.1.16 and illustrated in Fig. 4.19.

Detasseling time: Various detasseling time treatments showed significant results in potassium content (%) of baby corn, cob husk and fodder. Treatment D_2 (at tassel emergence) found significantly highest potassium content in baby corn, cob husk and fodder which was superior to D_1 (No detasseling), but it was found statistically at par with treatment D_3 (7 days after tassel emergence). The lowest values of potassium content (%) were recorded with treatment D_1 (No detasseling) during the experimentation.

Nitrogen levels: Different nitrogen levels significantly influenced the potassium content (%) of baby corn, cob husk and fodder. Potassium content (%) of baby corn, cob husk and fodder were recorded highest with treatment N_4 (200 kg N ha^{-1}) which was superior over treatment N_1 and N_2, but treatment N_3 (150 kg N ha^{-1}) found at par. However, the lowest potassium content (%) of bay corn, cob husk and fodder registered with treatment N_1 (50 kg N ha^{-1}) during the experimentation.

Interaction between nitrogen levels and detasseling time on potassium content (%) of baby corn, cob husk and fodder showed non-significant effects due to various treatments.

4.3.4 Protein content (%) of baby corn, cob husk and fodder

The data pertaining to the protein content (%) as influenced by various nitrogen levels and detasseling time have been presented in Table 4.1.17 and depicted in Fig 4.21.

Detasseling time: Data related to the protein content (%) of baby corn, cob husk and fodder showed significant influence due to the detasseling time treatments. Protein content (%) of baby corn, cob husk and fodder was significantly highest with the application of treatment D_2 (at tassel emergence) over the treatment D_1 (No detasseling), it was found statistically at par with treatment D_3 (7 days after tassel emergence). Similarly, the lowest protein content (%) of baby corn, cob husk and fodder was recorded with treatment D_1 (No detasseling) which was lower than treatment D_3 (7 days after tassel emergence) during the experimentation.

Nitrogen levels: Various nitrogen levels of winter baby corn significantly influenced the protein content (%) of baby corn, cob husk and fodder. The application of treatment N_4 (200 kg N ha^{-1}) recorded the highest protein content (%) of baby corn, cob husk and fodder which was superior over the treatments N_1 and N_2, but it was found statistically at par with treatment N_3 (150 kg N ha^{-1}). Similarly, the lowest protein content (%) was recorded with the treatment N_1 (50 kg N ha^{-1}) than the N_2 (100 kg N ha^{-1}) during the experimentation.

Interaction between the nitrogen levels and detasseling time failed to show any significant variation due to the various treatments.

4.3.5 Total carbohydrates content (%) in baby corn

The data analyzed during experimentation showed significant variation due to the effect of nitrogen levels and detasseling time and the same has been presented in Table 4.1.19. and Fig. 4.24.

Detasseling time: Total carbohydrates of baby corn recorded significant variation due to the effect of detasseling time. Application of treatment D_2 (At tassel emergence) registered highest carbohydrates in baby corn (69.78%) which was greater than the D_1 (No detasseling) but found at par with D_3 (7 days after tassel emergence). The lowest total carbohydrates (67.66%) observed with D_1 (No detasseling) compared to the D_3 (7 days after tassel emergence).

Nitrogen levels: Total carbohydrates of baby corn significantly varied due to nitrogen levels. The highest total carbohydrates (73.57%) recorded with the application of N_4 (200 kg N ha^{-1}) compared to the N_1 and N_2, and it was observed at par with N_3 (150 kg N ha^{-1}). Application of 50 kg N ha^{-1} (N_1) registered lowest total carbohydrates (63.54%) compared to the other treatments.

Interaction between nitrogen levels and detasseling found non-significant on total carbohydrates during experimentation.

4.3.6 Starch content (%) in baby corn

The data related to the starch content (%) in baby corn significantly varied due to various nitrogen levels and detasseling time and the same have been presented in Table 4.1.19. and Fig. 4.24.

Detasseling time: Significant variations showed on starch content (%) in baby corn due to the effect of various detasseling time treatments. The highest starch content

(64.68%) recorded with the application of treatments D_2 (at tassel emergence) compared to the D_1 (No detasseling), but observed at par with D_3 (7 days after tassel emergence). Similarly, the lowest starch content (56.51%) was registered with the application of D_1 (No detasseling) compared to the D_3 (7 days after tassel emergence).

Nitrogen levels: Different nitrogen levels tested in experiment varied significantly with respect to the starch content of baby corn. The highest starch content (65.18%) was recorded with the application of treatment N_4 (200 kg N ha^{-1}) compared to the other treatments, however, N_3 (150 kg N ha^{-1}) found at par. The lowest values (54.95%) recorded with the application of 50 kg N ha^{-1} (N_1) compared to the rest of the treatments.

Starch content (%) in baby corn did not influenced due to the various nitrogen levels and detasseling time during the experimentation.

4.3.7 Total soluble sugars content (%) in baby corn

The data related to the total soluble sugar content in baby corn showed significant variation due to the nitrogen levels and detasseling time and same have been presented in Table 4.1.19. and Fig. 4.24.

Detasseling time: Detasseling time treatments found to exert significant influence on total soluble sugar content in baby corn. Significantly highest total soluble sugar content (1.62%) was recorded with the application of treatment D_2 (At tassel emergence) which was superior over the D_1 (No detasseling), but observed at par with D_3 (7 days after tassel emergence). No detasseling (T_1) recorded lowest total soluble sugars content in baby corn (1.46%) than the other treatments.

Nitrogen levels: Total soluble sugar content (%) in baby corn significantly affected due to the nitrogen levels during the experimentation. Application of N_4 (200 kg N ha^{-1}) registered significantly highest total soluble sugar content (1.70%) which was higher than the N_1 and N_2, but was observed at par with N_3 (150 kg N ha^{-1}). The lowest total soluble sugar content (1.36%) was recorded with the application of 50 kg N ha^{-1} (N_1) compared to the other of the treatments.

The interaction between the nitrogen levels and detasseling failed to show any significant variation during experimentation.

4.4 Nutrient uptake (kg ha^{-1})

4.4.1 Nitrogen uptake (kg ha^{-1})

The observations presented in Table 4.1.14 and Fig. 4.16 related to the nitrogen uptake of baby corn, cob husk, fodder and total nitrogen uptake (kg ha^{-1}) was statistically influenced by various nitrogen levels and detasseling time treatment.

Detasseling time: Various detasseling time treatments tested in experimentation significantly influenced the nitrogen uptake by baby corn, cob husk and fodder. The highest nitrogen uptake of baby corn, cob husk and fodder was recorded with the application of treatment D_2 (at tassel emergence), but treatment D_3 (7 days after tassel emergence) found statistically at par. However, the lowest nitrogen uptake was noted with treatment D_1 (No detasseling). However, the total nitrogen uptake of baby corn, cob husk and fodder followed similar trend due to the effect of detasseling time.

Nitrogen levels: Nitrogen levels tested in experimentation significantly influenced the nitrogen uptake (kg ha^{-1}) of baby corn, cob husk and fodder. The treatment N_4 (200 kg N ha^{-1}) registered highest nitrogen uptake of baby corn, cob husk and fodder which was superior to the treatment N_1 and N_2, however, treatment N_3 (150 kg N ha^{-1}) was observed statistically at par regarding uptake of nitrogen. The treatment N_1 (50 kg N ha^{-1}) noted lowest nitrogen uptake by baby corn, cob husk and fodder in comparision to treatment N_2 (100 kg N ha^{-1}). The total nitrogen uptake of baby corn, cob husk and fodder influenced by the various nitrogen levels significantly due to the application of treatments N_4 (200 kg N ha^{-1}) compared to the rest of the treatments, but observed statistically at par with N_3 (150 kg N ha^{-1}) during experimetation.

The interaction effect between nitrogen levels and detasseling time treatments found non-significant.

4.4.2 Phosphorous uptake (kg ha^{-1})

The data noted during experimentation regarding phosphorous uptake of baby corn, cob husk, fodder and total P uptake resulted in significant variation due to nitrogen levels and detasseling time and have been presented in Table 4.1.15 and depicted in Fig. 4.18.

Detasseling time: Detasseling time treatments statistically influenced the phosphorous uptake of baby corn, cob husk and fodder. Significantly highest P uptake was recorded with treatment D_2 (at tassel emergence) which was higher than the D_1 (No detasseling), but statistically at par with D_3 (7 days after tassel emergence). Application of treatment D_1 (No detasseling) noted lowest P uptake by baby corn, cob husk and fodder when compared with treatment D_3 (7 days after tassel emergence). However, similar trend has been followed in the total phosphorous uptake of baby corn during experimentation.

Nitrogen levels: Various nitrogen levels applied in experimentation significantly influenced the phosphorus uptake of baby corn, cob husk and fodder. The highest phosphorous uptake was recorded with treatment N_4 (200 kg N ha^{-1}) over the treatments N_1 and N_2, but it was found statistically at par with N_3 (150 kg N ha^{-1}). Application of treatment N_1 (50 kg N ha^{-1}) registered the lowest P uptake by baby corn, cob husk and fodder during the experimentation. Similarly, the response of total phosphorous uptake of baby corn was significantly higher with treatment N_4 (200 kg N ha^{-1}) than with the other treatments.

The interaction effect between the nitrogen levels and detasseling time did not find significant variation due to various treatments.

4.4.3 Potassium uptake (kg ha^{-1})

The data pertaining to the potassium uptake of baby corn, cob husk, fodder and total potassium uptake was influenced by various nitrogen levels and detasseling time and have been presented in Table 4.1.16 and illustrated in Fig. 4.20.

Detasseling time: Detasseling time treatments in the experiment significantly influenced the potassium uptake of baby corn, cob husk, fodder and total potassium uptake. The highest potassium uptake by baby corn, cob husk, fodder and total potassium was recorded with treatment D_2 (At tassel emergence) over the treatment D_1 (No detasseling), however, it was found at par with the application of treatment D_3 (7 days after tassel emergence). The lowest potassium uptake of baby corn, cob husk, fodder and total potassium uptake was recorded with treatment D_1 (No detasseling) during the experimentation.

Nitrogen levels: Nitrogen levels tested in the experiment showed significant variation in the potassium uptake of baby corn, cob husk, fodder and total potassium uptake. Treatment N_4 (200 kg N ha^{-1}) found significantly highest potassium uptake by baby corn, cob husk, fodder and total potassium uptake which was superior over the treatments N_1 and N_2, but it was found statistically at par with N_3 (150 kg N ha^{-1}). The lowest values of baby corn, cob husk, fodder and total potassium uptake (kg ha^{-1}) were recorded with treatments N_1 (50 kg N ha^{-1}) when compared with N_2 (100 kg N ha^{-1}) during experimentation.

Interaction effect between the nitrogen levels and detasseling time found non-significant due to various treatments.

4.4.4 Protein harvest (kg ha^{-1})

The data presented in Table 4.1.17 and depicted in Fig 4.22 related to protein harvest of baby corn, cob husk, fodder and total protein harvest (kg ha^{-1}) as influenced by various nitrogen levels and detasseling time treatments.

Detasseling time: Detasseling time treatments examined in experiments showed significant variation in protein harvest of baby corn, cob husk, fodder and total protein harvest. Significantly highest protein harvest of baby corn, cob husk, fodder and total protein harvest was recorded with treatments D_2 (At tassel emergence) which was higher as compared to the D_1 (No detasseling), however statistically at par with treatment D_3 (7 days after tassel emergence). Application of treatment D_1 (No detasseling) has significantly lesser values compared to D_3 (7 days after tassel emergence) during the period of investigation.

Nitrogen levels: Nitrogen application through various levels significantly influenced the protein harvest of baby corn, cob husk, fodder and total protein harvest. Protein harvest of baby corn, cob husk, fodder and total protein harvest was significantly highest with the application of treatment N_4 (200 kg N ha^{-1}) which was superior over the treatments N_1 and N_2, however, treatment N_3 (150 kg N ha^{-1}) found statistically at par with N_4. Similarly, the lowest protein harvest of baby corn, cob husk, fodder and total protein harvest was recorded with treatment N_1 (50 kg N ha^{-1}) during the experimentation.

Protein harvest of baby corn, cob husk fodder and total protein harvest failed to show any significant variation due to interaction between nitrogen levels and detasseling time.

4.5 Nutrients availability

The data collected on the status of available N, P and K (kg ha^{-1}) in the soil as influenced by various treatments after the harvest of winter baby corn have been presented in Table 4.1.18 and illustrated in Fig 4.23.

4.5.1 Available N, P and K (kg ha^{-1}) in soil

The data pertaining to the available status of N, P and K in the soil after the winter baby corn harvest has significant variation in available N status, but available P and K in soil could not reach the level of significance and the data have been presented in Table 4.1.18.

Detasseling time: The detasseling time significantly influenced the available nitrogen, but available P and K (kg ha^{-1}) could not varied significantly due to the treatments. Significant variation in soil available nitrogen recorded with highest values with the application of treatment D_1 (No detasseling) which was higher than treatment D_2 (at tassel emergence), but it was found statistically at par with treatment D_3 (7 days after tassel emergence). Similarly, the lowest available nitrogen was recorded with treatment D_2 (at tassel emergence) compared with treatment D_3 (7 days after tassel emergence).

Nitrogen levels: Various nitrogen levels of winter baby corn showed significant variation in soil available nitrogen (kg ha^{-1}) however, available soil P and K found unaffected. Application of treatment N_4 (200 kg N ha^{-1}) accounted the highest nitrogen availability in soil and was superior over the treatments N_1 and N_2, but found at par with treatment N_3 (150 kg N ha^{-1}). Similarly, the lowest available nitrogen in the soil was recorded with treatment N_1 (50 kg N ha^{-1}) which was the lowest value with treatment N_2 (100 kg N ha^{-1}) during the experimentation.

Interaction effect between nitrogen levels and detasseling time on available nutrients in soil after harvest of baby corn found non-significant due to different treatments.

4.6 Economics of baby corn

Analyzed data related to the economics of baby corn was influenced due to various nitrogen levels and detasseling time on winter baby corn have been presented in Table 4.1.20 and depicted in Fig 4.25.

4.6.1 Cost of cultivation (₹ ha^{-1})

Detasseling time: The data related to the cost of cultivation of baby corn varied with different treatments due to involvement of their cost. Application of treatments D_2 (at tassel emergence) and D_3 (7 days after tassel emergence), the cost of cultivation (₹ 77662.27 ha^{-1}) was similar due to the involvement of labor cost for detasseling operation. However, the lowest cost of cultivation (₹ 75742.27 ha^{-1}) involved in treatment D_1 (No detasseling) which do not involve any labor cost for detasseling operation.

Nitrogen levels: The cost of cultivation of nitrogen levels varied with levels. The highest cost of cultivation involved in the treatment of N_4 (200 kg N ha^{-1}) because of the varied fertilizer cost and labor costs. Similarly, the lowest cost of cultivation involved in treatment N_1 (50 kg N ha^{-1}) due to less fertilizer requirement in this treatment. The cost of cultivation found in order of N_4>N_3>N_2>N_1.

4.6.2 Gross returns (₹ ha^{-1})

Detasseling time: Detasseling time treatments investigated in the experiment on baby corn caused significant variation in gross returns. Application of treatment D_2 (at tassel emergence) resulted significantly highest gross returns (₹ 231715.27 ha^{-1}) superior over the treatment D_1 (No detasseling), but it was found at par with D_3 (7 days after tassel emergence). The lowest gross returns (₹ 211345.10 ha^{-1}) recorded with treatment D_1 (No detasseling) during experimentation. The order of gross return with detasseling time was D_2>D_3>D_1.

Nitrogen levels: Various nitrogen levels tested in experimentation resulted significant variation in the gross returns. Significantly highest gross returns (₹264361.05 ha^{-1}) were found with the application of treatment N_4 (200 kg N ha^{-1}) which was higher than the rest of the treatments, but treatment N_3 (150 kg N ha^{-1}) was found statistically at par. Similarly, the lowest gross returns (₹170697.21 ha^{-1}) were noted with treatment N_1 (50 kg N ha^{-1}) compared with treatment N_2 (100 kg N ha^{-1}) during the period of investigation. The trend of gross returns was recorded as N_4>N_3>N_2>N_1.

Interaction effect between the nitrogen levels and detasseling time on gross returns of baby corn found non-significant.

4.6.3 Net returns (₹ ha^{-1})

Detasseling time: Due to the application of various detasseling time treatments net returns of baby corn significantly varied. Application of treatment D_2 (at tassel emergence) recorded the highest net returns from baby corn (₹154053.01 ha^{-1}) over the treatment D_1 (No detasseling), however statistically at par with treatment D_3 (7 days after tassel emergence). The lowest net returns of baby corn (₹135602.83 ha^{-1}) registered with treatment D_1 (No detasseling) compared to the other treatments during experimentation. The increasing order of net returns of baby corn was $D_1 < D_3 < D_2$.

Nitrogen levels: Various nitrogen levels of baby corn influenced the net returns of baby corn and significantly varied. Significantly highest net returns of baby corn (₹ 186391.53 ha^{-1}) were noted with treatment N_4 (200 kg N ha^{-1}) which was greater than the other treatments, but it was found statistically at par with treatment N_3 (150 kg N ha^{-1}). Lowest net returns of baby corn (₹ 94782.19 ha^{-1}) registered with treatments N_1 (50 kg N ha^{-1}) when compared to the remaining treatments. The increasing order of net returns of baby corn due to the various nitrogen levels was $N_1<N_2<N_3<N_4$.

The interaction effect between the nitrogen levels and detasseling time on net returns of baby corn found non-significant during the experimentation.

4.6.4 Benefit: cost ratio

Detasseling time: Benefit: cost ratio of baby corn was affected due to the various treatments of detasseling time caused significant variation. Application of treatment D_2 (at tassel emergence) resulted in significantly highest benefit: cost ratio of baby corn (1.98) which was superior over the treatment D_1 (No detasseling), but statistically at par with treatment D_3 (7 days after tassel emergence). Lowest benefit: cost ratio (1.79) was recorded with the application of treatment D_1 (No detasseling) during the experimentation. $D_2 > D_3 > D_1$ found in decreasing order of benefit: cost ratio due to various detasseling time treatments.

Nitrogen levels: Nitrogen levels tested in experimentation exhibited significant variation in the benefit: cost ratio. The treatment N_4 (200 kg N ha^{-1}) recorded the highest benefit: cost ratio of baby corn (2.39) when compared to the rest of the treatment, but it was found at par with treatment N_3 (150 kg N ha^{-1}). Application of treatment N_1 (50 kg N ha^{-1}) resulted in the lowest benefit: cost ratio of baby corn (1.25) when compared to the other treatments. The order of benefit: cost ratio due to various nitrogen levels was $N_4>N_3>N_2>N_1$.

Interaction effect between the nitrogen levels and detasseling time on the benefit: cost ratio was found non-significant during the experimentation.

Table 4.1.1: Effect of nitrogen levels and detasseling time on plant height (cm) at different growth stages of winter baby corn

Treatment	30 DAS	60 DAS	90 DAS	At harvest
Detasseling time				
D_1 No detasseling (control)	21.45	58.55	111.69	186.79
D_2 At tassel emergence	20.80	60.13	115.86	189.40
D_3 7days after tassel emergence	22.00	61.66	115.35	189.27
S Em ±	0.41	1.09	2.84	1.98
CD (p=0.05)	NS	NS	NS	NS
Nitrogen levels (kg ha^{-1})				
N_1 :50	21.11	55.96	103.94	171.22
N_2 : 100	21.21	59.94	112.31	182.96
N_3 : 150	21.79	61.12	119.64	197.61
N_4 : 200	21.55	63.42	121.30	202.17
S Em ±	0.47	1.26	3.28	2.29
CD (p=0.05)	NS	3.69	9.63	6.71

Table 4.1.2: Effect of nitrogen levels and detasseling time on number of leaves at different growth stages of winter baby corn

Treatment	30 DAS	60 DAS	90 DAS	At harvest
Detasseling time				
D_1 : No detasseling (control)	4.93	9.93	10.75	14.08
D_2 :At tassel emergence	4.95	9.92	10.87	14.13
D_3 :7days after tassel emergence	5.05	9.88	11.05	13.79
S Em ±	0.04	0.08	0.14	0.21
CD (p=0.05)	NS	NS	NS	NS
Nitrogen levels (kg ha^{-1})				
N_1 : 50	4.91	9.74	10.20	13.50
N_2 : 100	4.96	9.81	10.76	13.83
N_3 : 150	5.00	9.89	11.16	14.00
N_4 : 200	5.04	10.20	11.44	14.67
S Em ±	0.05	0.09	0.16	0.24
CD (p=0.05)	NS	0.28	0.47	0.70

Table 4.1.3: Effect of nitrogen levels and detasseling time on dry matter accumulation (g plant^{-1}) at different growth stages of winter baby corn

Treatment	30 DAS	60 DAS	90 DAS	At harvest
Detasseling time				
D_1 : No detasseling (control)	0.29	4.35	20.88	56.44
D_2 :At tassel emergence	0.32	4.32	21.72	58.77
D_3 :7days after tassel emergence	0.30	4.09	20.86	58.38
S Em ±	0.01	0.13	1.43	0.73
CD (p=0.05)	NS	NS	NS	NS
Nitrogen levels (kg ha^{-1})				
N_1 : 50	0.28	3.87	17.47	44.01
N_2 : 100	0.30	4.21	20.17	55.33
N_3 : 150	0.31	4.41	22.41	65.33
N_4 : 200	0.32	4.52	24.57	66.77
S Em ±	0.01	0.15	1.65	0.85
CD (p=0.05)	NS	0.45	4.84	2.48

4.1.4: Effect of nitrogen levels and detasseling time on leaf area index at different growth stages of winter baby corn

Treatment	40 DAS	60 DAS	90 DAS
Detasseling time			
D_1 : No detasseling (control)	0.21	1.20	3.28
D_2 :At tassel emergence	0.20	1.15	3.09
D_3 :7days after tassel emergence	0.20	1.13	3.08
S Em ±	0.01	0.03	0.12
CD (p=0.05)	NS	NS	NS
Nitrogen levels (kg ha^{-1})			
N_1 : 50	0.19	1.08	2.18
N_2 : 100	0.20	1.11	2.86
N_3 : 150	0.21	1.22	3.64
N_4 : 200	0.22	1.23	3.91
S Em ±	0.01	0.04	0.14
CD (p=0.05)	0.02	0.11	0.42

Table 4.1.5: Effect of nitrogen levels and detasseling time on chlorophyll content (SPAD) at different growth stages of winter baby corn

Treatment	30 DAS	60 DAS	90 DAS	At harvest
Detasseling time				
D_1 : No detasseling (control)	31.10	32.36	36.54	39.65
D_2 :At tassel emergence	30.90	32.93	37.78	37.88
D_3 :7days after tassel emergence	31.08	32.05	38.59	39.84
S Em ±	0.33	0.33	0.69	1.04
CD (p=0.05)	NS	NS	NS	NS
Nitrogen levels (kg ha^{-1})				
N_1 : 50	29.84	31.60	30.38	29.93
N_2 : 100	30.73	32.12	35.28	35.10
N_3 : 150	31.87	32.80	41.16	42.32
N_4 : 200	31.67	33.27	43.74	49.13
S Em ±	0.38	0.38	0.79	1.20
CD (p=0.05)	1.11	1.12	2.32	3.51

Table 4.1.6: Effect of nitrogen levels and detasseling time on initial plant population (ha^{-1}), final plant population (ha^{-1}), barren plants (ha^{-1}), barrenness (%) of winter baby corn

Treatment	Initial Plant Population (ha^{-1})	Final plant population (ha^{-1})	Barren plants (ha^{-1})	Barrenness (%)
Detasseling time				
D_1 No detasseling (control)	122895.62	121326.18	1499.37	1.24
D_2 At tassel emergence	123369.11	122137.21	1657.20	1.36
D_3 7days after tassel emergence	122527.36	121672.56	1736.11	1.43
S Em ±	323.30	315.20	122.87	0.10
CD (p=0.05)	NS	NS	NS	NS
Nitrogen levels (kg ha^{-1})				
N_1 :50	122685.19	121323.23	1788.72	1.47
N_2 : 100	121633.00	121025.25	1683.50	1.39
N_3 : 150	123526.94	122264.31	1578.28	1.29
N_4 : 200	123877.67	122235.13	1473.06	1.20
S Em ±	373.32	363.96	141.88	0.12
CD (p=0.05)	NS	NS	NS	NS

Table 4.1.7: Effect of nitrogen levels and detasseling time on days to initiation of baby cob harvest and days to 50% silk emergence of winter baby corn

Treatment	Days to initiation of baby cob harvest	Days to 50% silk emergence
Detasseling time		
D_1 No detasseling (control)	116.83	118.67
D_2 At tassel emergence	116.00	117.79
D_3 7days after tassel emergence	116.58	118.33
S Em ±	0.24	0.25
CD (p=0.05)	NS	NS
Nitrogen levels (kg ha^{-1})		
N_1 :50	118.00	120.17
N_2 : 100	117.22	119.33
N_3 : 150	115.56	117.00
N_4 : 200	115.11	116.56
S Em ±	0.27	0.29
CD (p=0.05)	0.81	0.85

Table 4.1.8: Effect of nitrogen levels and detasseling time on period of harvest (days) and baby cobs plant^{-1} of winter baby corn

Treatment	Period of harvest (days)	Baby cobs plant^{-1}
Detasseling time		
D_1 No detasseling (control)	16.75	3.50
D_2 At tassel emergence	17.50	3.68
D_3 7days after tassel emergence	17.17	3.57
S Em ±	0.16	0.04
CD (p=0.05)	0.46	0.11
Nitrogen levels (kg ha^{-1})		
N_1 :50	13.56	3.03
N_2 : 100	16.56	3.49
N_3 : 150	18.67	3.83
N_4 : 200	19.78	3.97
S Em ±	0.18	0.04
CD (p=0.05)	0.54	0.13

Table 4.1.9: Effect of nitrogen levels and detasseling time on baby corn length (cm) and baby corn girth (cm) of winter baby corn

Treatment	Baby corn length (cm)	Baby corn girth (cm)
Detasseling time		
D_1 No detasseling (control)	9.34	1.29
D_2 At tassel emergence	10.44	1.35
D_3 7days after tassel emergence	9.65	1.32
S Em ±	0.27	0.01
CD (p=0.05)	0.78	0.03
Nitrogen levels (kg ha^{-1})		
N_1 :50	9.19	1.25
N_2 : 100	9.33	1.28
N_3 : 150	10.23	1.34
N_4 : 200	10.48	1.41
S Em ±	0.31	0.01
CD (p=0.05)	0.90	0.03

Table 4.1.10: Effect of nitrogen levels and detasseling time on baby cob weight, baby corn weight and baby cob: baby corn ratio of winter baby corn

Treatment	Baby cob weight (g)	Baby corn weight (g)	Baby cob: baby corn ratio
Detasseling time			
D_1 No detasseling (control)	36.87	7.97	4.64
D_2 At tassel emergence	39.43	8.89	4.45
D_3 7days after tassel emergence	37.86	8.32	4.56
S Em ±	0.44	0.12	0.08
CD (p=0.05)	1.29	0.34	NS
Nitrogen levels (kg ha^{-1})			
N_1 :50	34.85	7.60	4.59
N_2 : 100	36.70	8.04	4.57
N_3 : 150	39.28	8.71	4.53
N_4 : 200	41.39	9.20	4.51
S Em ±	0.51	0.13	0.09
CD (p=0.05)	1.49	0.39	NS

Table 4.1.11: Effect of nitrogen levels and detasseling time on baby cob yield (kg ha^{-1}), baby corn yields (kg ha^{-1}) and fodder yield (t ha^{-1}) of winter baby corn

Treatment	Baby cob Yield (kg ha^{-1})	Baby corn yield (kg ha^{-1})	Fodder Yield (t ha^{-1})
Detasseling time			
D_1 No detasseling (control)	8011.75	1736.33	23.17
D_2 At tassel emergence	9040.33	2046.03	23.84
D_3 7days after tassel emergence	8512.42	1867.82	23.26
S Em ±	112.44	41.37	0.72
CD (p=0.05)	329.77	121.33	NS
Nitrogen levels (kg ha^{-1})			
N_1 :50	6480.89	1416.23	18.56
N_2 : 100	7970.78	1750.79	20.85
N_3 : 150	9367.33	2079.47	26.57
N_4 : 200	10267.00	2287.09	27.71
S Em ±	129.83	47.77	0.83
CD (p=0.05)	380.78	140.10	2.44

Table 4.1.12: Effect of nitrogen levels and detasseling time on picking wise baby cob yield

Treatment	I Picking (kg ha^{-1})	II Picking (kg ha^{-1})	III Picking (kg ha^{-1})	IV Picking (kg ha^{-1})
Detasseling time				
D_1 No detasseling (control)	2545.42	3422.00	1765.75	278.58
D_2 At tassel emergence	2886.83	3785.25	1983.67	384.58
D_3 7days after tassel emergence	2722.92	3599.08	1869.17	321.25
S Em ±	44.53	70.68	58.03	13.85
CD (p=0.05)	130.60	207.28	170.20	40.64
Nitrogen levels (kg ha^{-1})				
N_1 :50	2001.56	2913.44	1373.89	192.00
N_2 : 100	2471.44	3457.56	1771.67	270.11
N_3 : 150	3061.11	3837.33	2103.22	365.67
N_4 : 200	3339.44	4200.11	2242.67	484.78
S Em ±	51.42	81.61	67.01	15.99
CD (p=0.05)	150.80	239.35	196.53	46.92

Table 4.1.13: Effect of nitrogen levels and detasseling time on picking wise yield of winter baby corn

Treatment	I Picking (kg ha^{-1})	II Picking (kg ha^{-1})	III Picking (kg ha^{-1})	IV Picking (kg ha^{-1})
Detasseling time				
D_1 No detasseling (control)	551.97	741.27	382.72	60.37
D_2 At tassel emergence	653.02	857.72	448.18	87.10
D_3 7days after tassel emergence	597.46	791.11	408.82	70.43
S Em ±	14.37	23.84	12.86	2.69
CD (p=0.05)	42.14	69.91	37.71	7.88
Nitrogen levels (kg ha^{-1})				
N_1 :50	437.72	636.82	299.63	42.06
N_2 : 100	542.19	760.55	388.63	59.42
N_3 : 150	679.65	853.40	465.16	81.27
N_4 : 200	743.71	936.04	499.56	107.79
S Em ±	16.59	28.52	14.85	3.10
CD (p=0.05)	48.66	80.73	43.54	9.10

Table 4.1.14: Effect of nitrogen levels and detasseling time on N content (%) and N uptake (kg ha^{-1}) by baby corn, husk, fodder and total N uptake of winter baby corn (on dry weight basis)

Treatment	Nitrogen (%)			Nitrogen uptake (kg ha^{-1})			
	Baby corn	Husk	Fodder	Baby corn	Husk	Fodder	Total N uptake (kg ha^{-1})
Detasseling time							
D_1 No detasseling (control)	1.91	1.10	1.09	3.38	40.14	73.63	117.15
D_2 At tassel emergence	2.26	1.30	1.14	4.71	51.88	87.68	144.27
D_3 7days after tassel emergence	2.09	1.14	1.11	3.93	44.66	79.32	127.90
S Em ±	0.06	0.04	0.03	0.16	1.59	2.33	2.78
CD (p=0.05)	0.18	0.12	0.08	0.46	4.67	6.82	8.15
Nitrogen levels (kg ha^{-1})							
N_1 :50	1.87	0.99	0.91	2.91	29.40	48.66	80.96
N_2 : 100	1.96	1.13	1.02	3.64	40.34	68.38	112.36
N_3 : 150	2.24	1.24	1.20	4.53	50.81	95.81	151.14
N_4 : 200	2.29	1.35	1.33	4.95	61.69	107.99	174.63
S Em ±	0.07	0.05	0.03	0.18	1.84	2.68	3.21
CD (p=0.05)	0.21	0.13	0.10	0.54	5.39	7.87	9.41

Table 4.1.15: Effect of nitrogen levels and detasseling time on phosphorous content (%) and phosphorous uptake (kg ha^{-1}) by baby corn, husk, fodder and total phosphorous uptake of winter baby corn (on dry weight basis)

Treatment	Phosphorous (%)			Phosphorous uptake (kg ha^{-1})			
	Baby corn	Husk	Fodder	Baby corn	Husk	Fodder	Total P uptake (kg ha^{-1})
Detasseling time							
D_1 No detasseling (control)	0.37	0.23	0.11	0.65	8.35	7.96	16.96
D_2 At tassel emergence	0.43	0.26	0.14	0.89	10.42	10.50	21.82
D_3 7days after tassel emergence	0.41	0.24	0.12	0.77	9.51	8.61	18.89
S Em ±	0.01	0.01	0.01	0.03	0.30	0.58	0.72
CD (p=0.05)	0.02	0.02	0.02	0.08	0.88	1.71	2.12
Nitrogen levels (kg ha^{-1})							
N_1 :50	0.37	0.20	0.07	0.57	5.88	3.56	10.02
N_2 : 100	0.38	0.23	0.12	0.70	8.09	7.79	16.58
N_3 : 150	0.42	0.26	0.14	0.85	10.53	11.58	22.96
N_4 : 200	0.44	0.29	0.16	0.96	13.21	13.15	27.32
S Em ±	0.01	0.01	0.01	0.03	0.35	0.67	0.83
CD (p=0.05)	0.03	0.02	0.03	0.10	1.02	1.98	2.44

Table 4.1.16: Effect of nitrogen levels and detasseling time on plant potassium content (%) and potassium uptake (kg ha^{-1}) by baby corn, husk, fodder and total potassium uptake of winter baby corn (on dry weight basis)

Treatment	Potassium (%)			Potassium uptake (kg ha^{-1})			
	Baby corn	Husk	Fodder	Baby corn	Husk	Fodder	Total K uptake (kg ha^{-1})
Detasseling time							
D_1 No detasseling (control)	1.34	0.66	1.69	2.35	14.91	116.05	133.31
D_2 At tassel emergence	1.39	0.86	1.80	2.87	22.67	132.56	158.10
D_3 7days after tassel emergence	1.36	0.75	1.73	2.55	18.76	123.02	144.33
S Em ±	0.01	0.05	0.02	0.07	1.24	2.06	2.39
CD (p=0.05)	0.04	0.15	0.05	0.20	3.62	6.05	7.01
Nitrogen levels (kg ha^{-1})							
N_1 :50	1.28	0.50	1.59	1.99	10.04	85.07	97.10
N_2 : 100	1.33	0.61	1.64	2.44	15.69	110.16	128.29
N_3 : 150	1.41	0.88	1.82	2.84	22.89	145.17	170.90
N_4 : 200	1.42	1.03	1.90	3.08	26.51	155.11	184.70
S Em ±	0.02	0.06	0.02	0.08	1.43	2.38	2.76
CD (p=0.05)	0.04	0.17	0.06	0.23	4.19	6.99	8.09

Table 4.1.17: Effect of nitrogen levels and detasseling time on protein content (%) and protein harvest (kg ha^{-1}) by baby corn, husk, fodder and total protein harvest of winter baby corn (on dry weight basis)

Treatment	Protein (%)			Protein harvest (kg ha^{-1})			
	Baby corn	Husk	Fodder	Baby corn	Husk	Fodder	Total protein harvest (kg ha^{-1})
Detasseling time							
D_1 No detasseling (control)	11.93	6.89	6.62	21.14	147.16	460.22	628.52
D_2 At tassel emergence	14.14	8.09	7.34	29.45	205.69	548.01	783.15
D_3 7days after tassel emergence	13.08	7.15	6.90	24.55	172.44	495.72	692.70
S Em ±	0.38	0.25	0.18	0.99	5.96	14.53	14.92
CD (p=0.05)	1.12	0.72	0.53	2.90	17.49	42.62	43.75
Nitrogen levels (kg ha^{-1})							
N_1 :50	11.67	6.21	5.66	18.19	134.04	304.11	456.33
N_2 : 100	12.22	7.09	6.38	22.74	181.23	427.38	631.35
N_3 : 150	14.00	7.76	7.50	28.29	185.64	598.83	812.76
N_4 : 200	14.32	8.46	8.29	30.96	199.48	674.94	905.38
S Em ±	0.44	0.29	0.21	1.14	6.88	16.78	17.23
CD (p=0.05)	1.29	0.84	0.61	3.35	20.19	49.21	50.52

Table 4.1.18: Effect of nitrogen levels and detasseling time on available soil nutrients after harvest of winter baby corn

Treatment	Nitrogen (kg ha^{-1})	Phosphorous (kg ha^{-1})	Potassium (kg ha^{-1})
Detasseling time			
D_1 No detasseling (control)	202.87	14.36	184.40
D_2 At tassel emergence	178.60	14.41	187.49
D_3 7days after tassel emergence	182.33	14.22	186.18
S Em ±	4.97	0.11	1.82
CD (p=0.05)	14.59	NS	NS
Nitrogen levels (kg ha^{-1})			
N_1 :50	169.56	14.19	182.92
N_2 : 100	182.49	14.13	185.81
N_3 : 150	190.61	14.60	188.70
N_4 : 200	209.07	14.40	186.65
S Em ±	5.74	0.12	2.10
CD (p=0.05)	16.85	NS	NS

4.1.19 Effect of nitrogen levels and detasseling time on quality parameters of winter baby corn (on dry weight basis)

Treatment	Total carbohydrates (%)	Starch (%)	Total soluble sugars (%)
Detasseling time			
D_1 No detasseling (control)	67.66	56.51	1.46
D_2 At tassel emergence	69.78	64.68	1.62
D_3 7days after tassel emergence	69.30	62.38	1.53
S Em ±	0.58	1.86	0.04
CD (p=0.05)	1.69	5.45	0.12
Nitrogen levels (kg ha^{-1})			
N_1 :50	63.54	54.95	1.36
N_2 : 100	66.68	61.46	1.46
N_3 : 150	71.87	63.17	1.63
N_4 : 200	73.57	65.18	1.70
S Em ±	0.67	2.15	0.05
CD (p=0.05)	1.96	6.30	0.14

Table 4.1.20: Effect of nitrogen levels and detasseling time on economics of winter baby corn

Treatment	Economics			
Treatment	**Cost of Cultivation (₹ ha^{-1})**	**Gross returns (₹ ha^{-1})**	**Net Returns (₹ ha^{-1})**	**Benefit : Cost Ratio**
Detasseling time				
D_1 No detasseling (control)	75742.27	211345.10	135602.83	1.79
D_2 At tassel emergence	77662.27	231715.27	154053.01	1.98
D_3 7days after tassel emergence	77662.27	219053.77	141391.50	1.82
S Em ±	-	4182.43	4182.43	0.05
CD (p=0.05)	-	12266.64	12266.64	0.16
Nitrogen levels (kg ha^{-1})				
N_1 :50	75915.03	170697.21	94782.19	1.25
N_2 : 100	76812.90	200539.48	123726.57	1.61
N_3 : 150	77391.64	247221.13	169829.50	2.19
N_4 : 200	77969.51	264361.05	186391.53	2.39
S Em ±	-	4829.45	4829.45	0.06
CD (p=0.05)	-	14164.30	14164.30	0.18

Fig. 3.1 Standard week – wise meteorological parameters during crop season (Winter, 2021-2022)

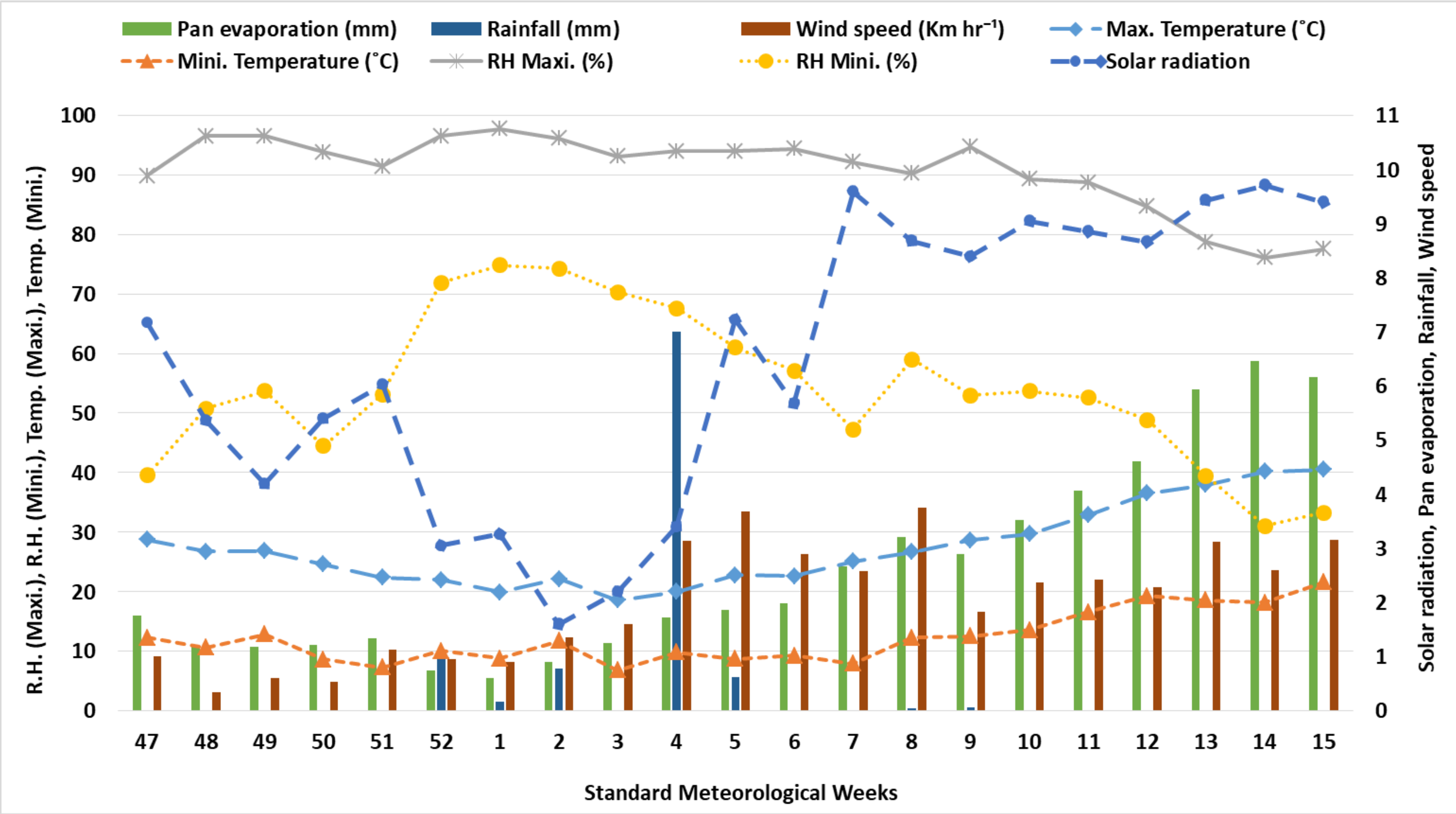


Fig: 4.1: Effect of nitrogen levels and detasseling time on plant height (cm) at different growth stages of winter baby corn

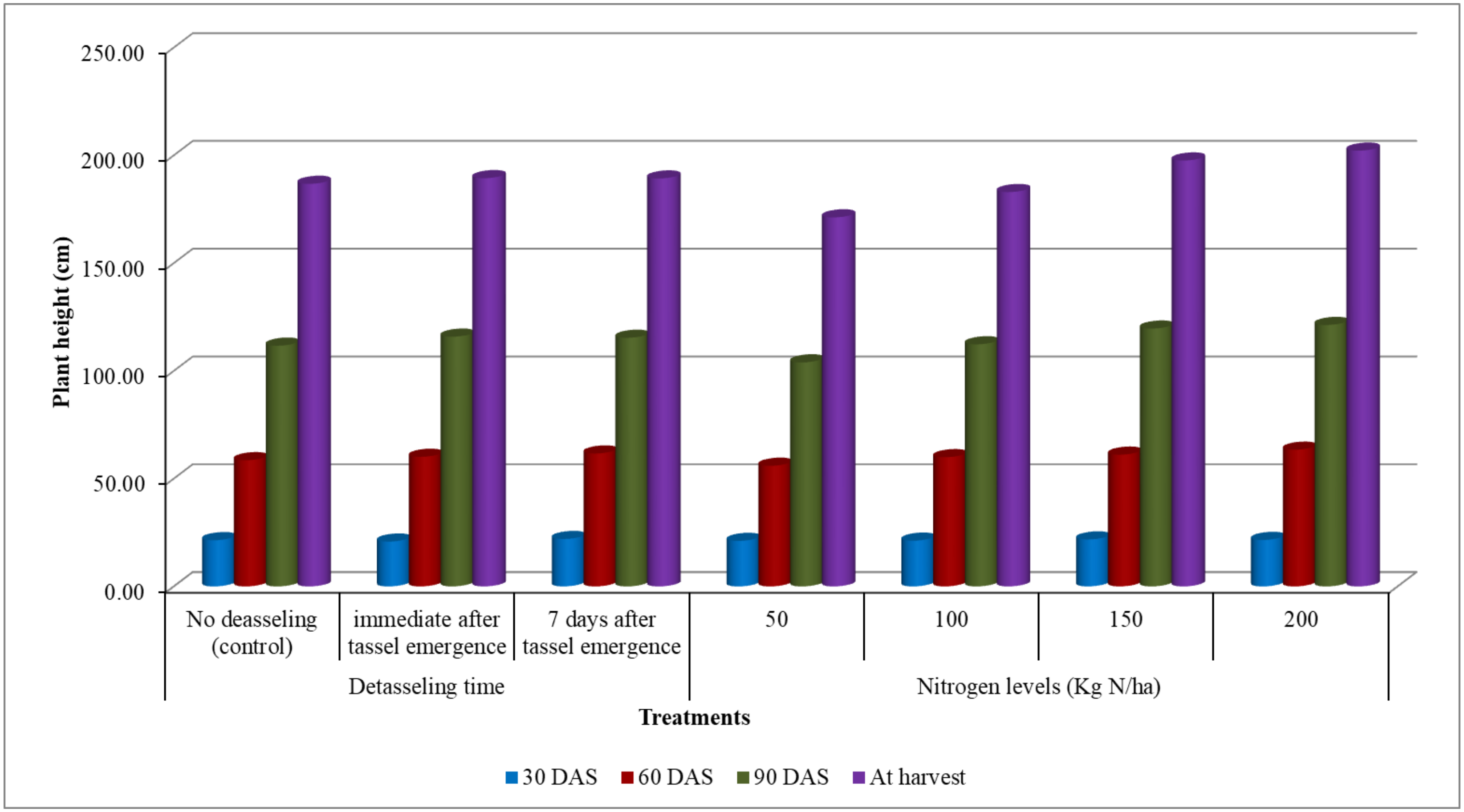


Fig: 4.2: Effect of nitrogen levels and detasseling time on no. of leaves plant^{-1} at different growth stages of winter baby corn

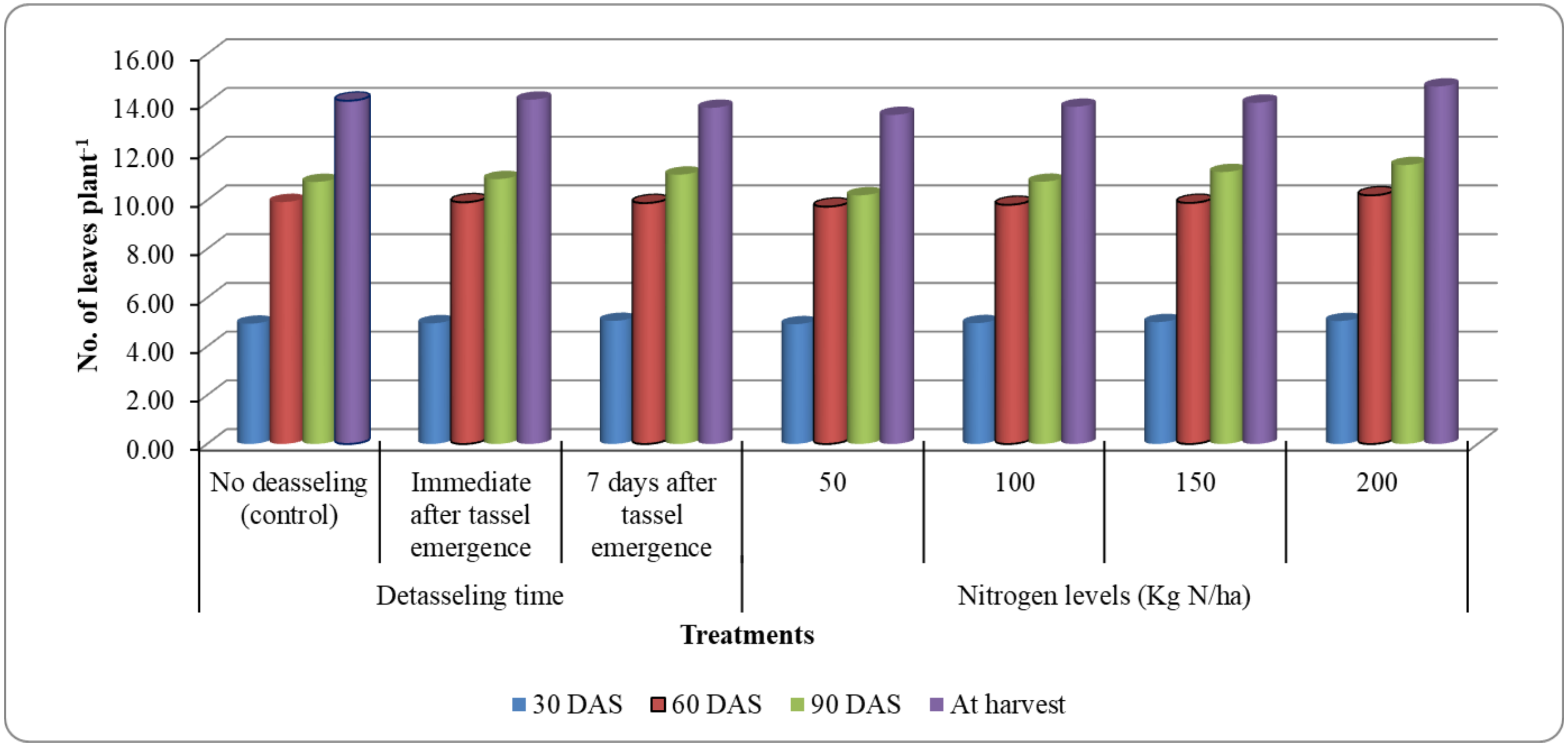


Fig: 4.3: Effect of nitrogen levels and detasseling time on dry matter accumulation (g plant^{-1}) at different growth stages of winter baby corn

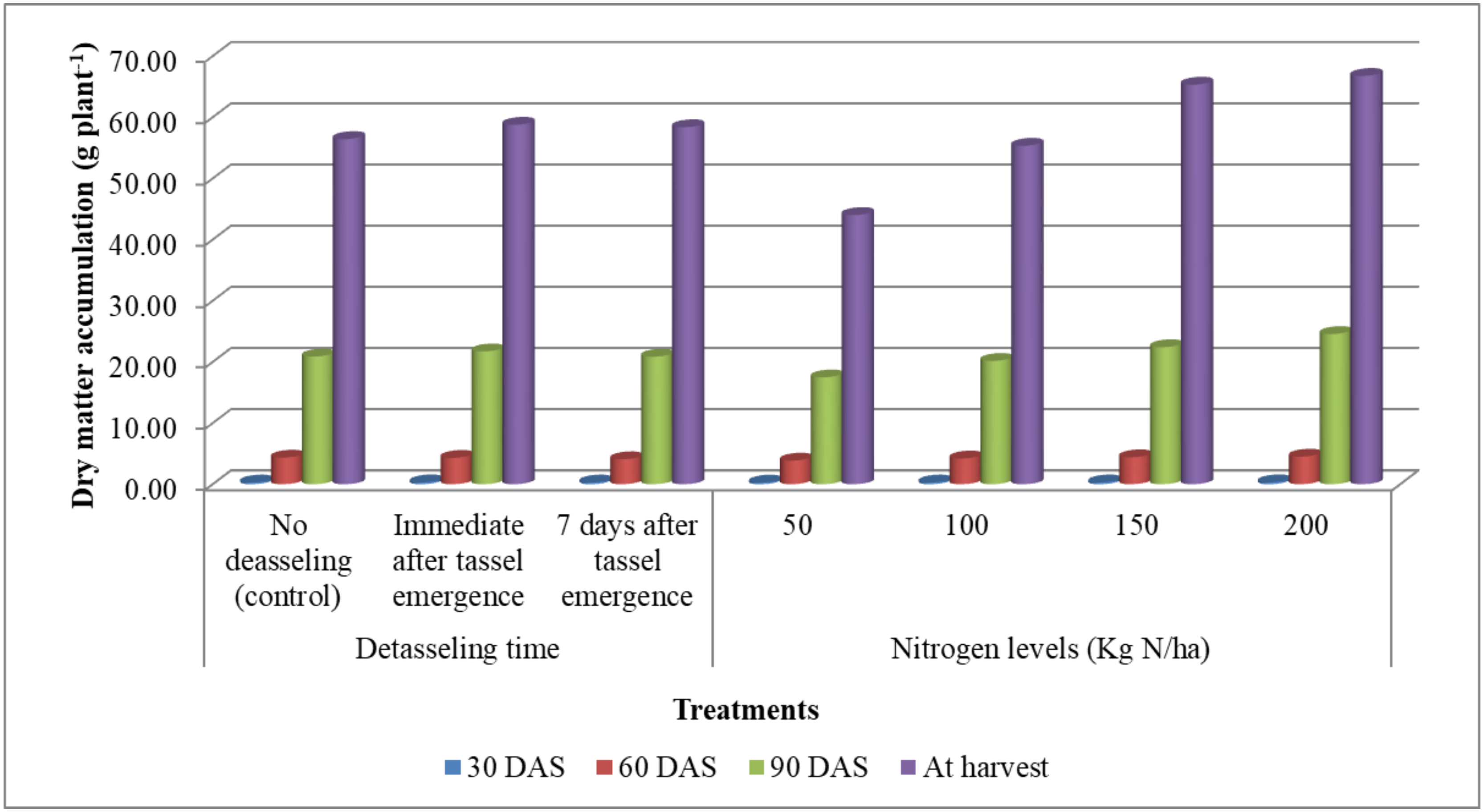


Fig: 4.4. Effect of nitrogen levels and detasseling time on leaf area index at different growth stages of winter baby corn

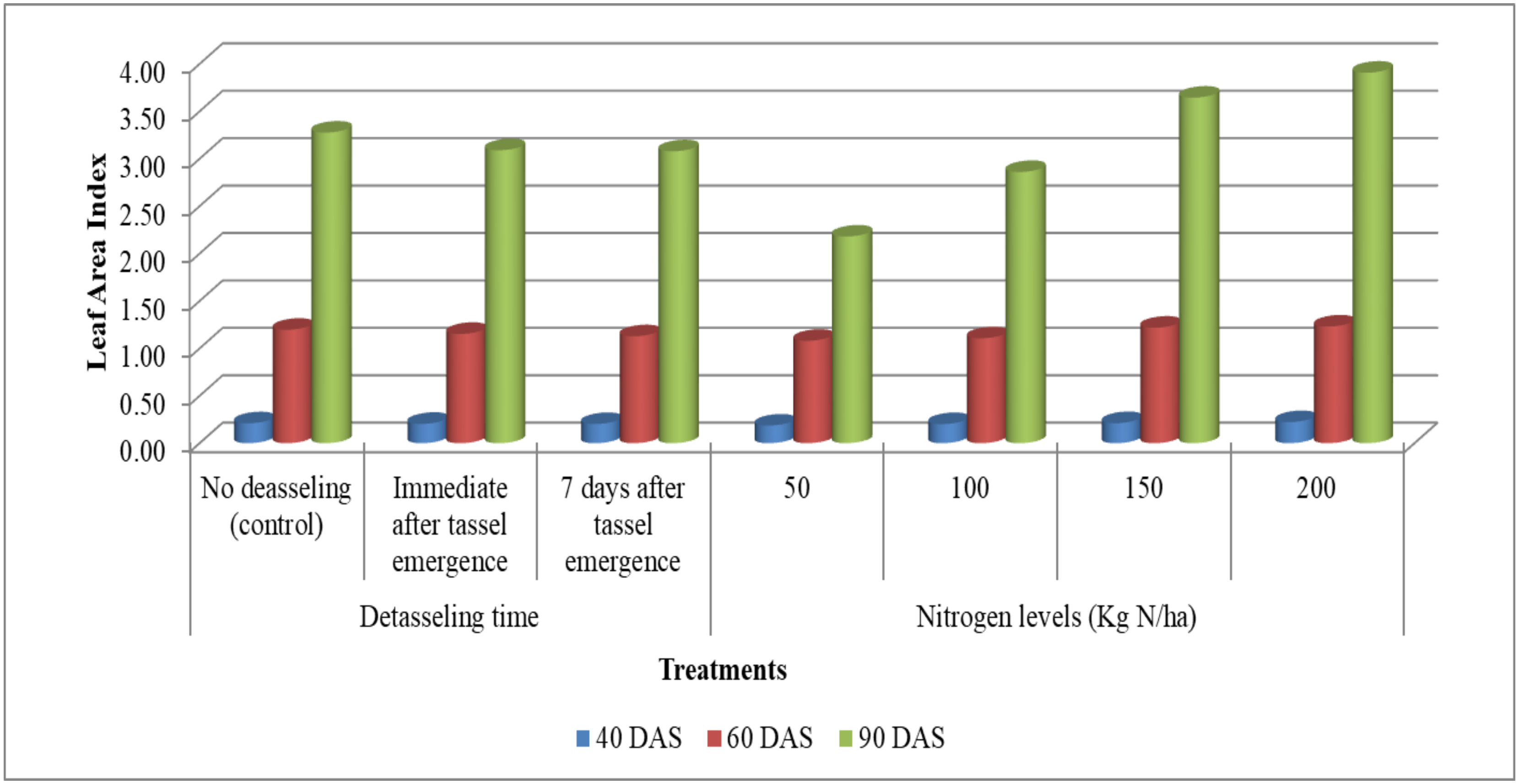


Fig: 4.5: Effect of nitrogen levels and detasseling time on chlorophyll content (SPAD value) at different growth stages of winter baby corn

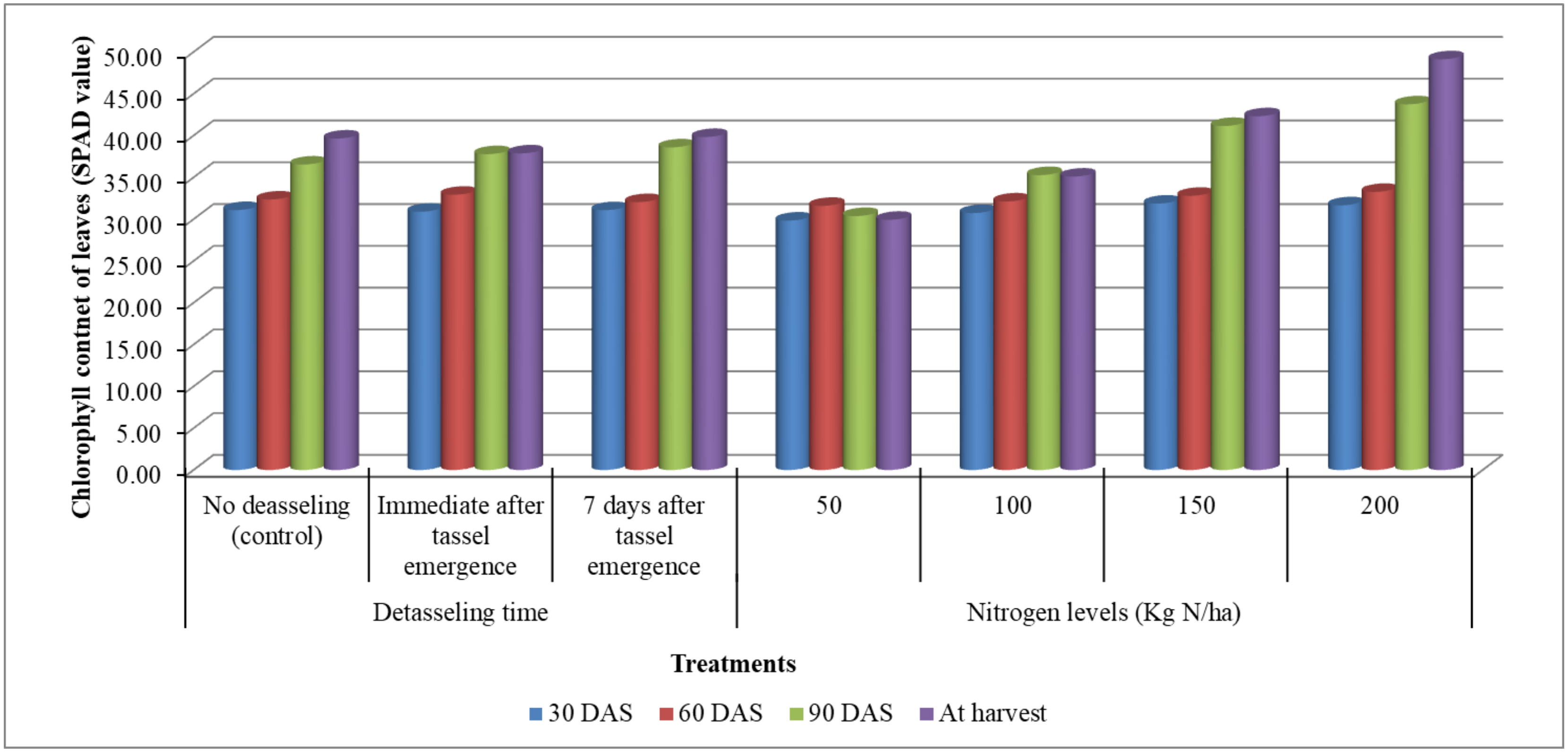


Fig: 4.6: Effect of nitrogen levels and detasseling time on initial and final plant population (ha^{-1}) of winter baby corn

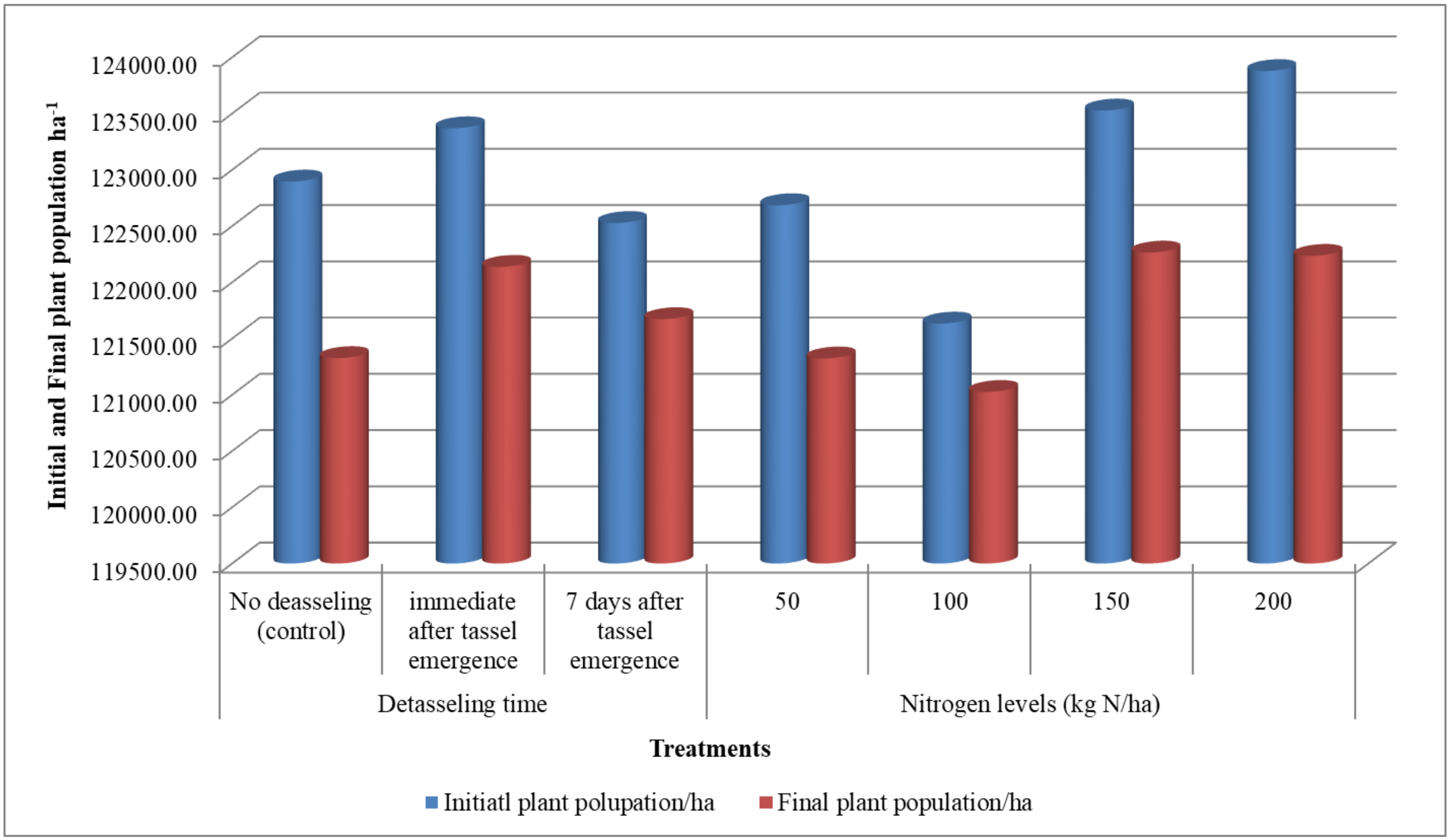


Fig: 4.7: Effect of nitrogen levels and detasseling time on barren plants (ha^{-1}), barrenness (%) of winter baby corn

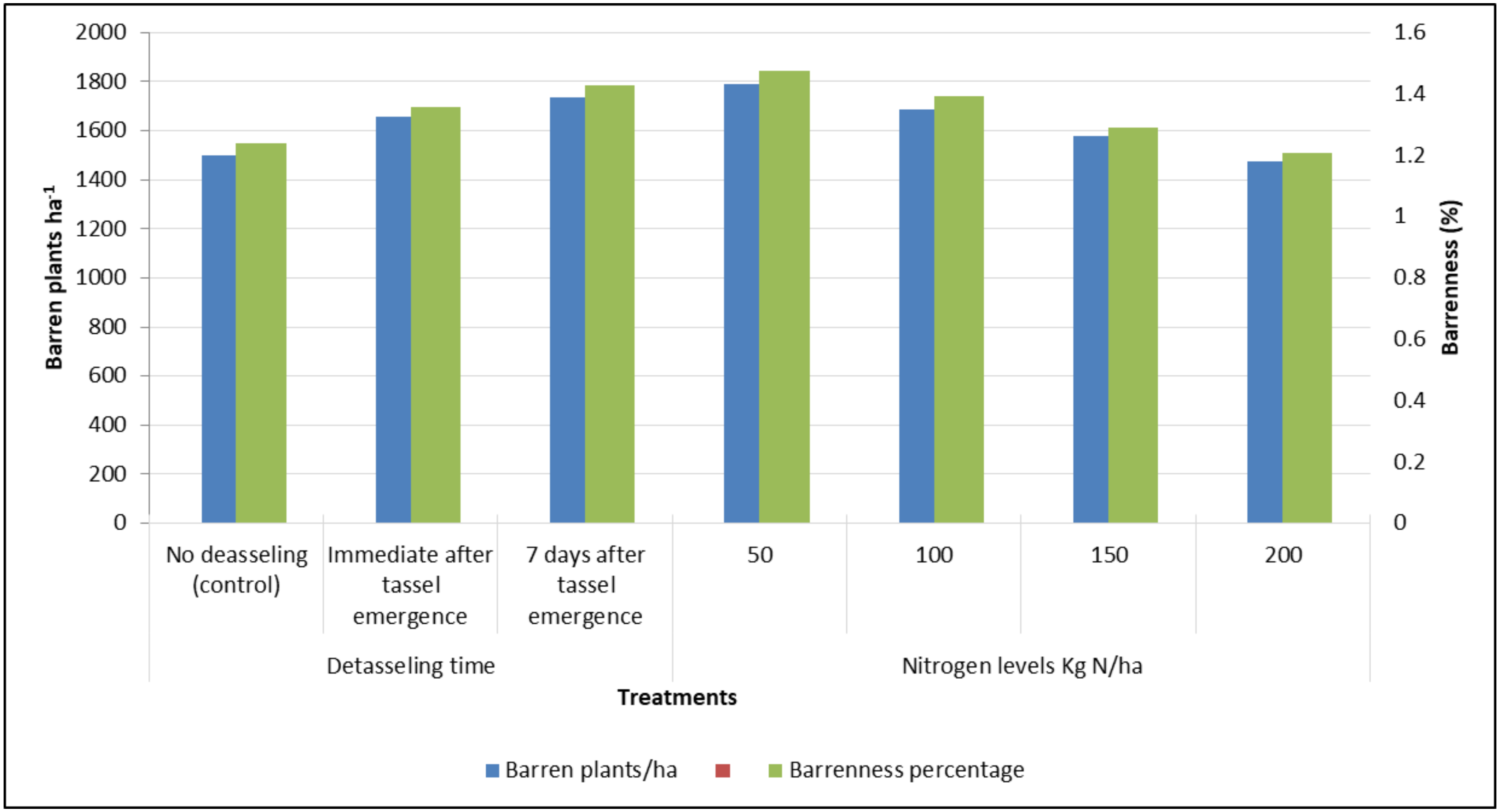


Fig: 4.8: Effect of nitrogen levels and detasseling time on days to initiation of baby cob harvest and 50% silk emergence (days) of winter baby corn

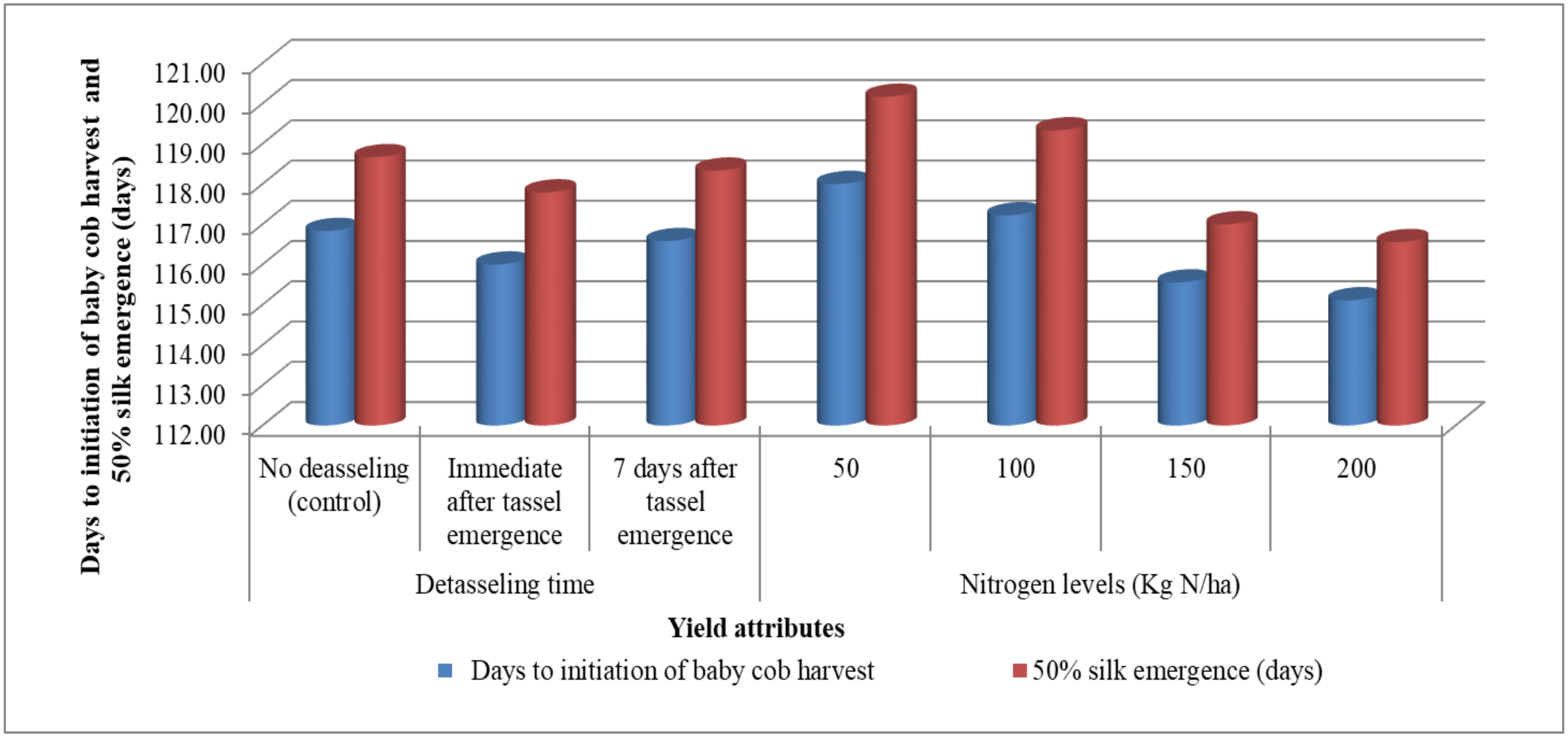


Fig: 4.9: Effect of nitrogen levels and detasseling time on period of harvest (days), baby cobs plant^{-1} of winter baby corn

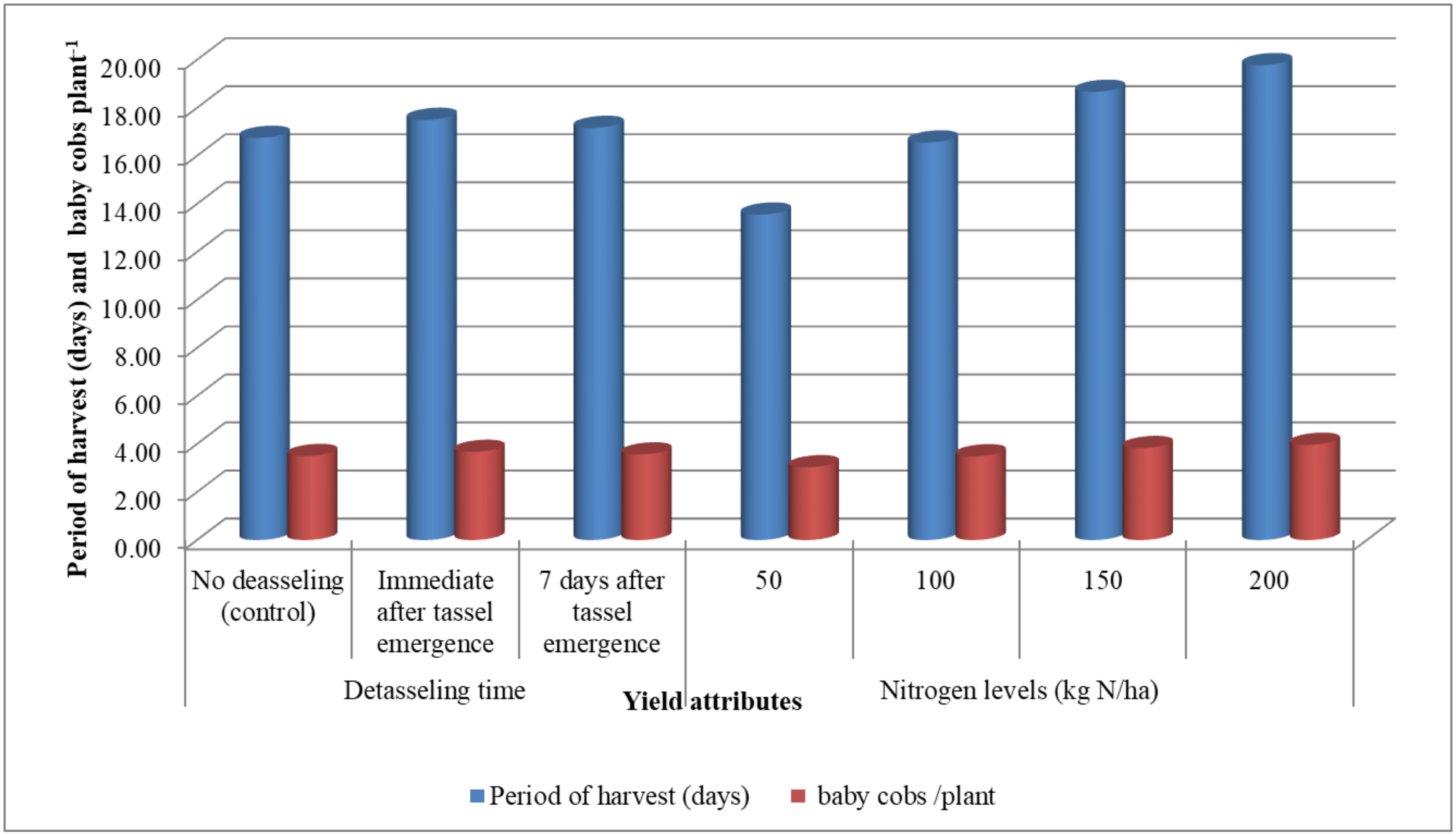


Fig: 4.10: Effect of nitrogen levels and detasseling time on baby corn length and baby corn girth of winter baby corn

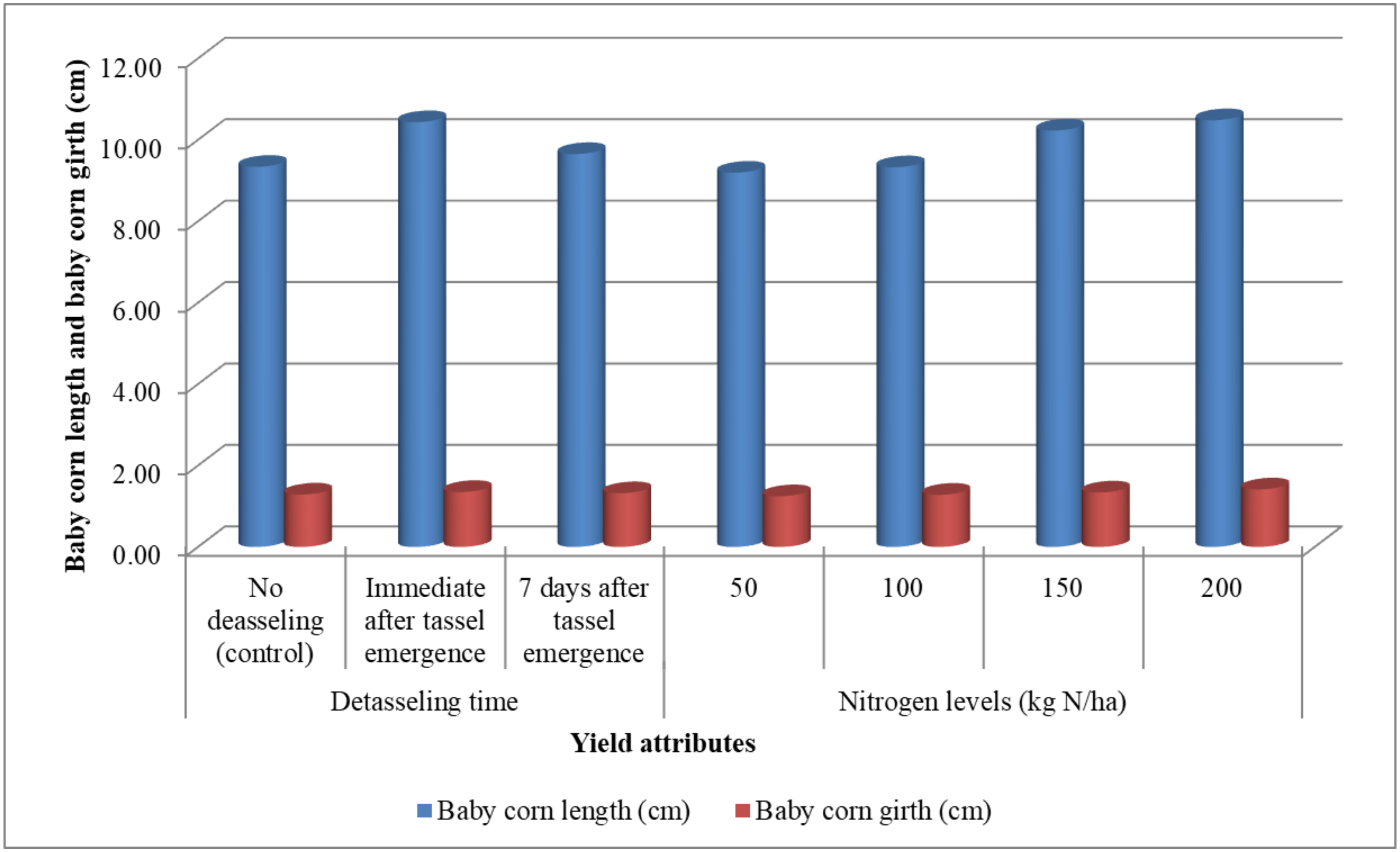


Fig: 4.11: Effect of nitrogen levels and detasseling time on baby cob weight, baby corn weight and baby: corn ratio of winter baby corn

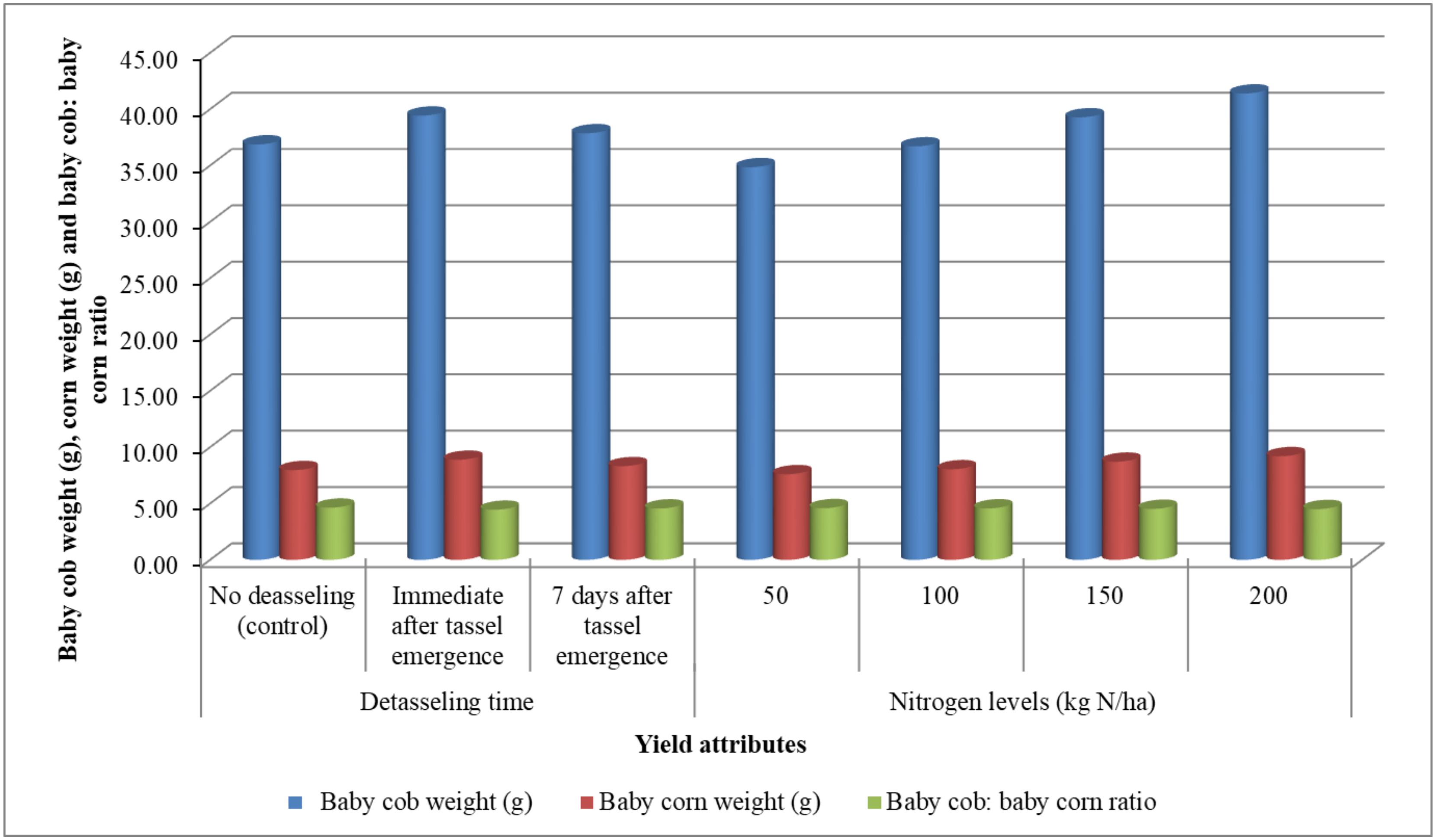


Fig: 4.12. Effect of nitrogen levels and detasseling time on baby cob yield (kg ha^{-1}), baby corn yield (kg ha^{-1}) and fodder yield (t ha^{-1}) of winter baby corn

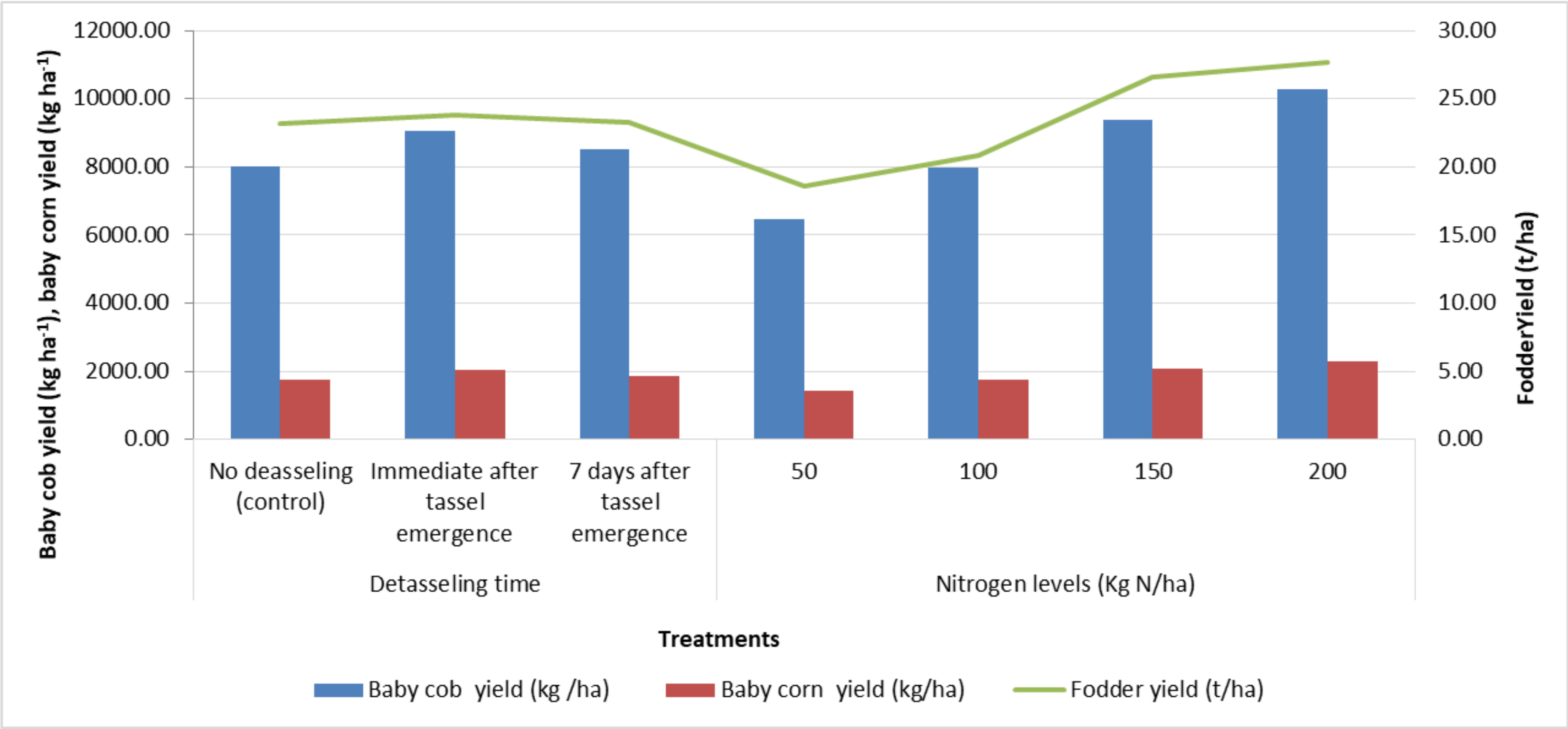


Fig: 4.13: Effect of nitrogen levels and detasseling time on picking wise baby cob yield (kg ha^{-1}) of winter baby corn

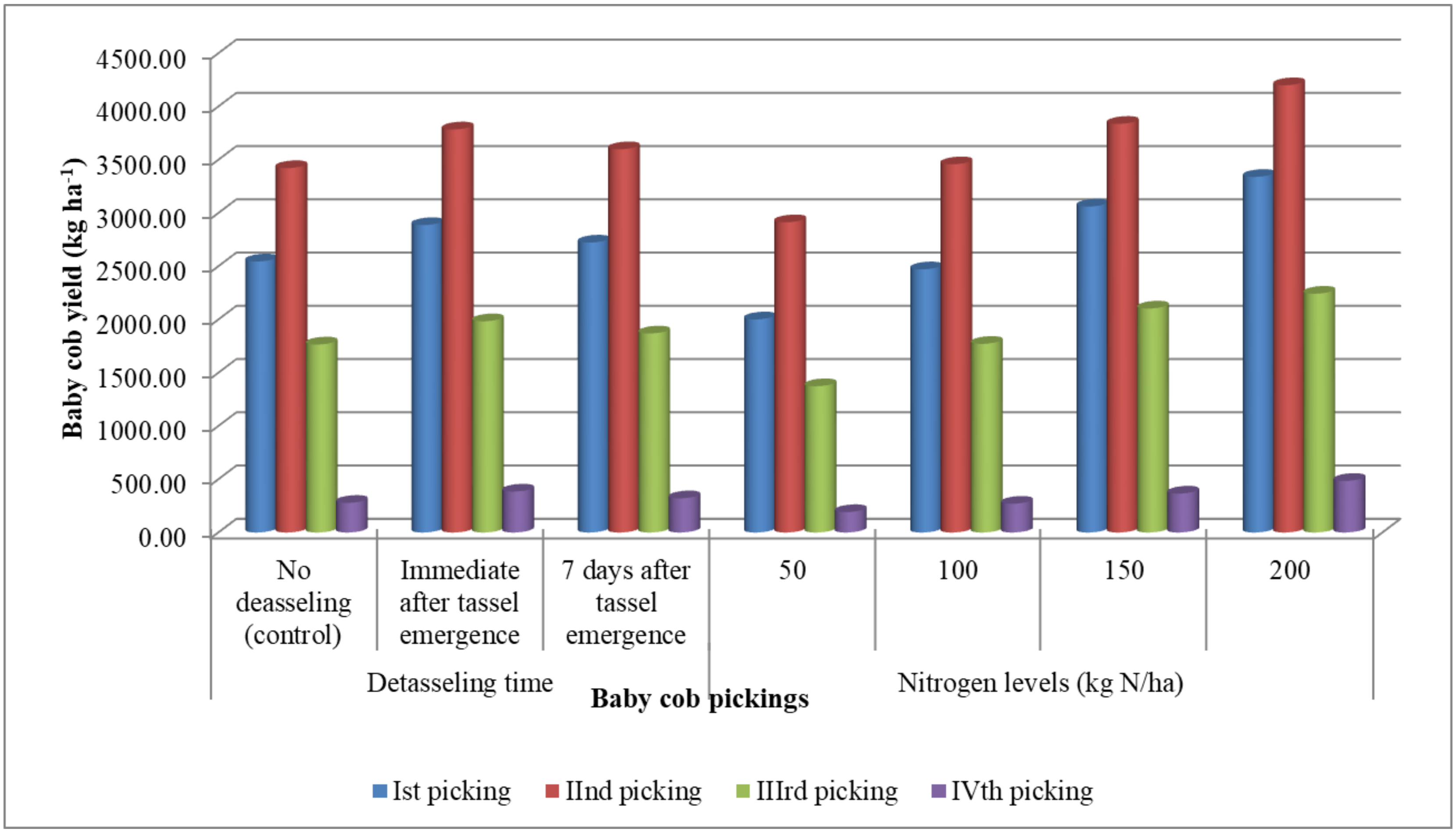


Fig: 4.14: Effect of nitrogen levels and detasseling time on picking wise baby corn yield (kg ha^{-1}) of winter baby corn

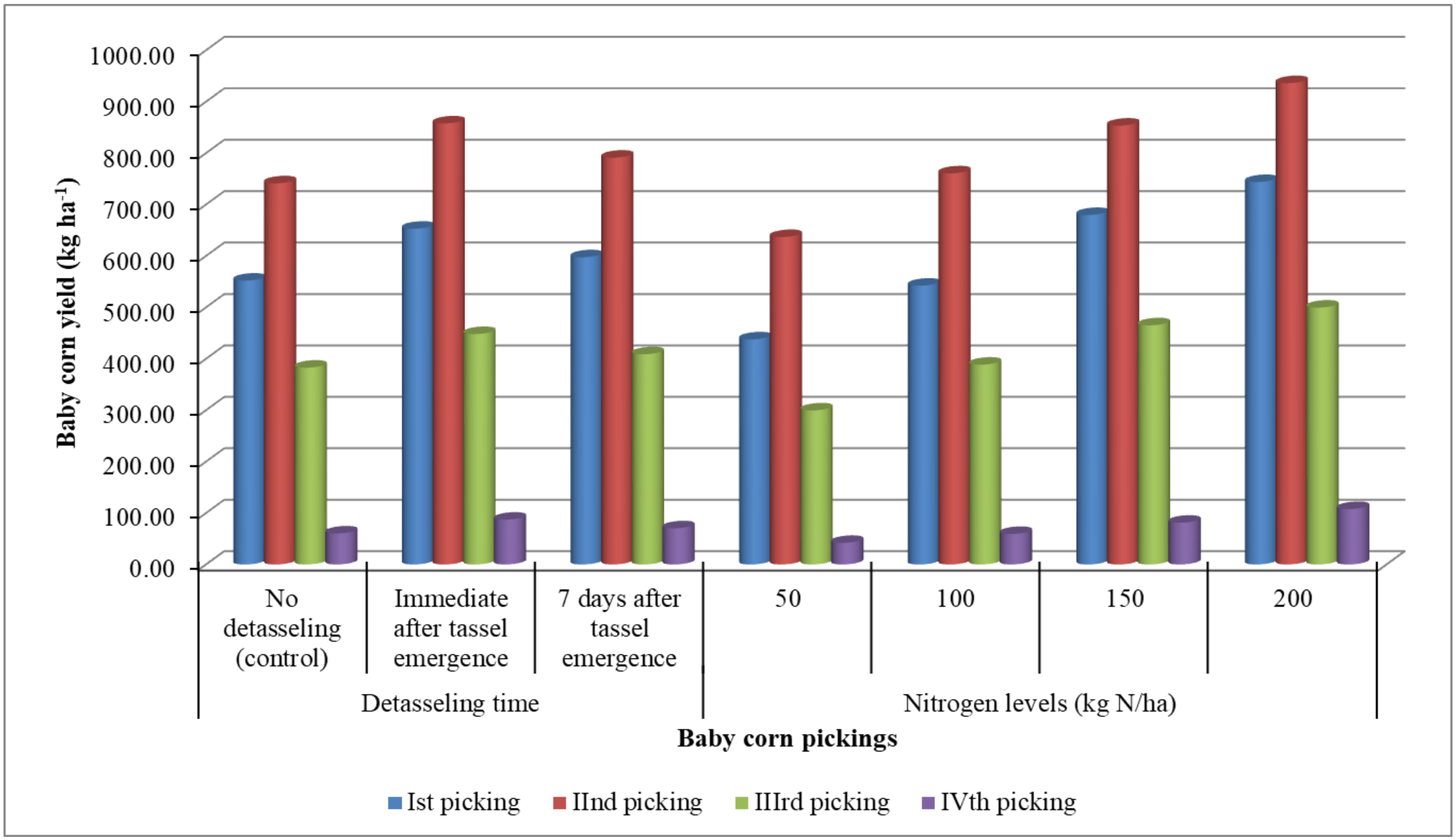


Fig: 4.15: Effect of nitrogen levels and detasseling time on nitrogen content (%) of baby corn, cob husk and fodder of winter baby corn

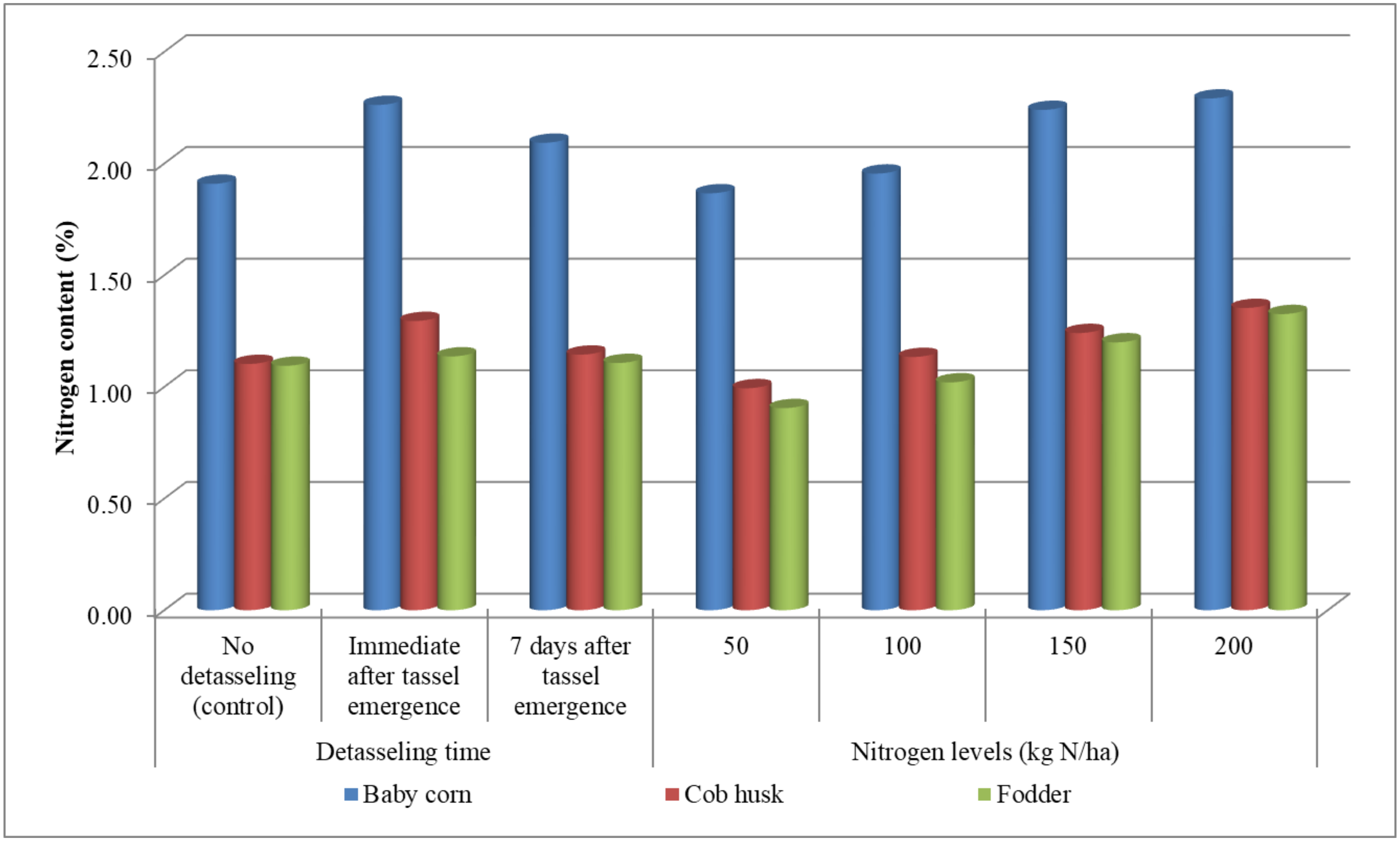


Fig: 4.16: Effect of nitrogen levels and detasseling time on nitrogen uptake (kg ha^{-1}) of baby corn, cob husk and fodder of winter baby corn

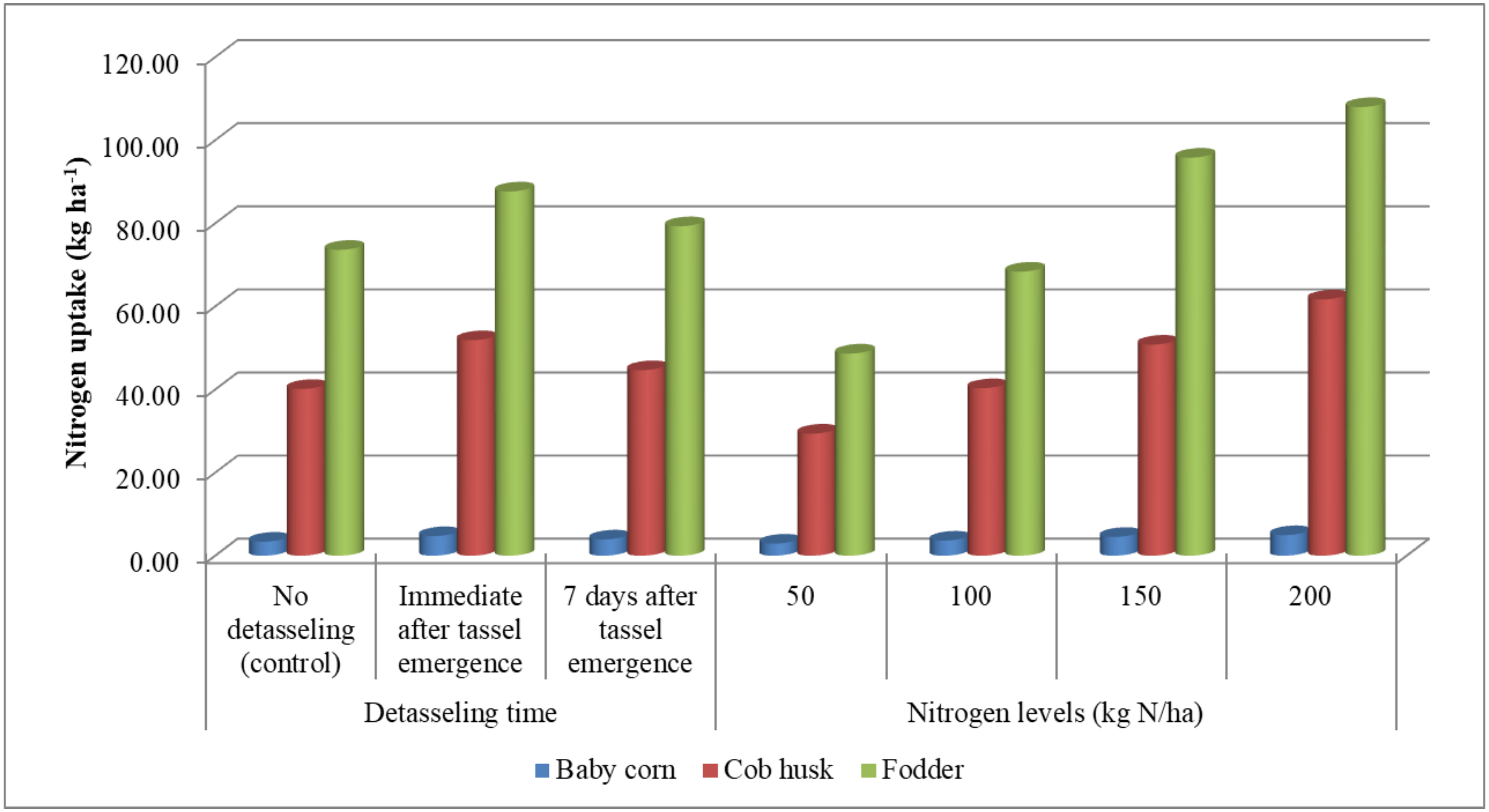


Fig: 4.17: Effect of nitrogen levels and detasseling time on phosphorous content (%) of baby corn, cob husk and fodder of winter baby corn

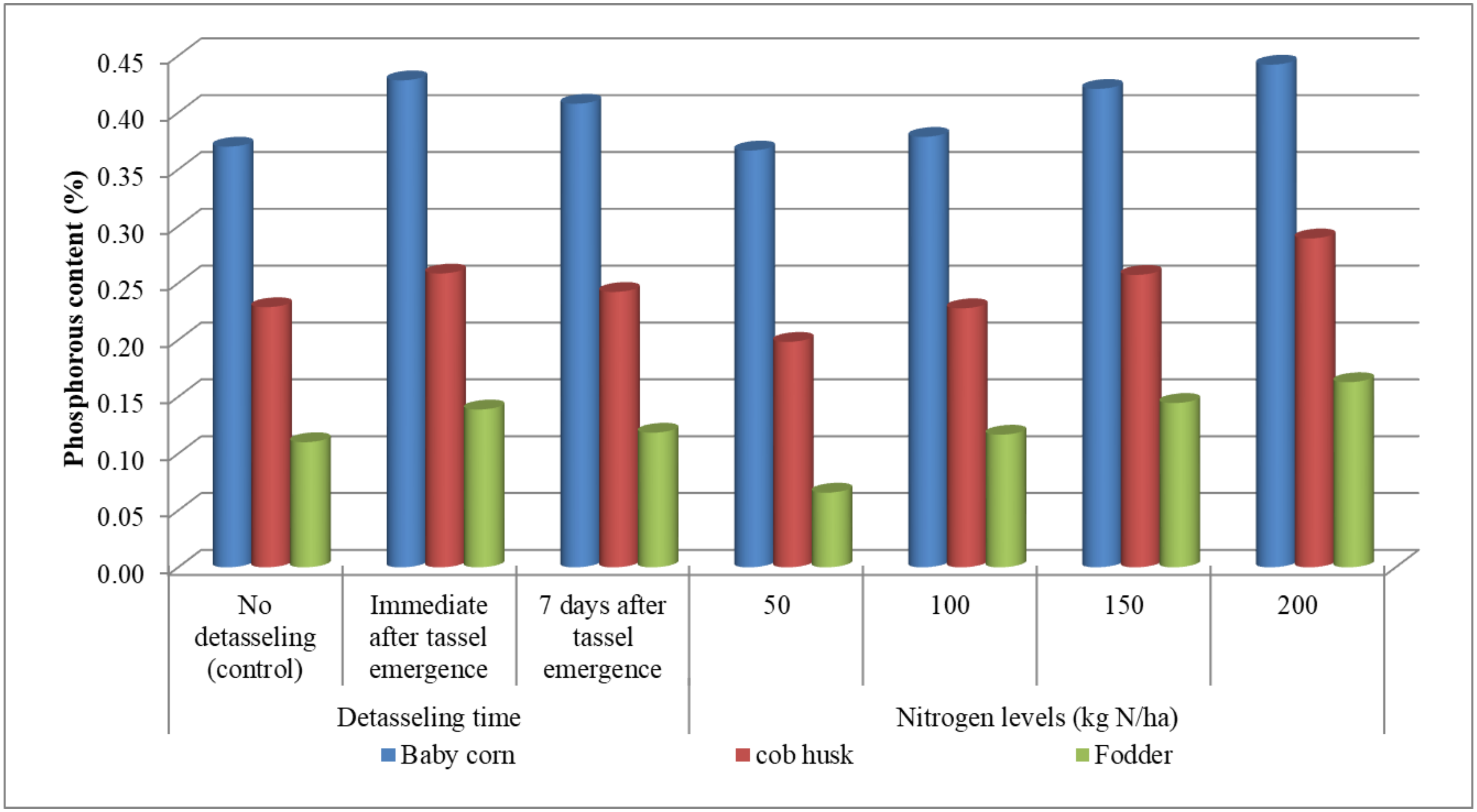


Fig: 4.18: Effect of nitrogen levels and detasseling time on phosphorous uptake (kg ha^{-1}) of baby corn, cob husk and fodder of winter baby corn

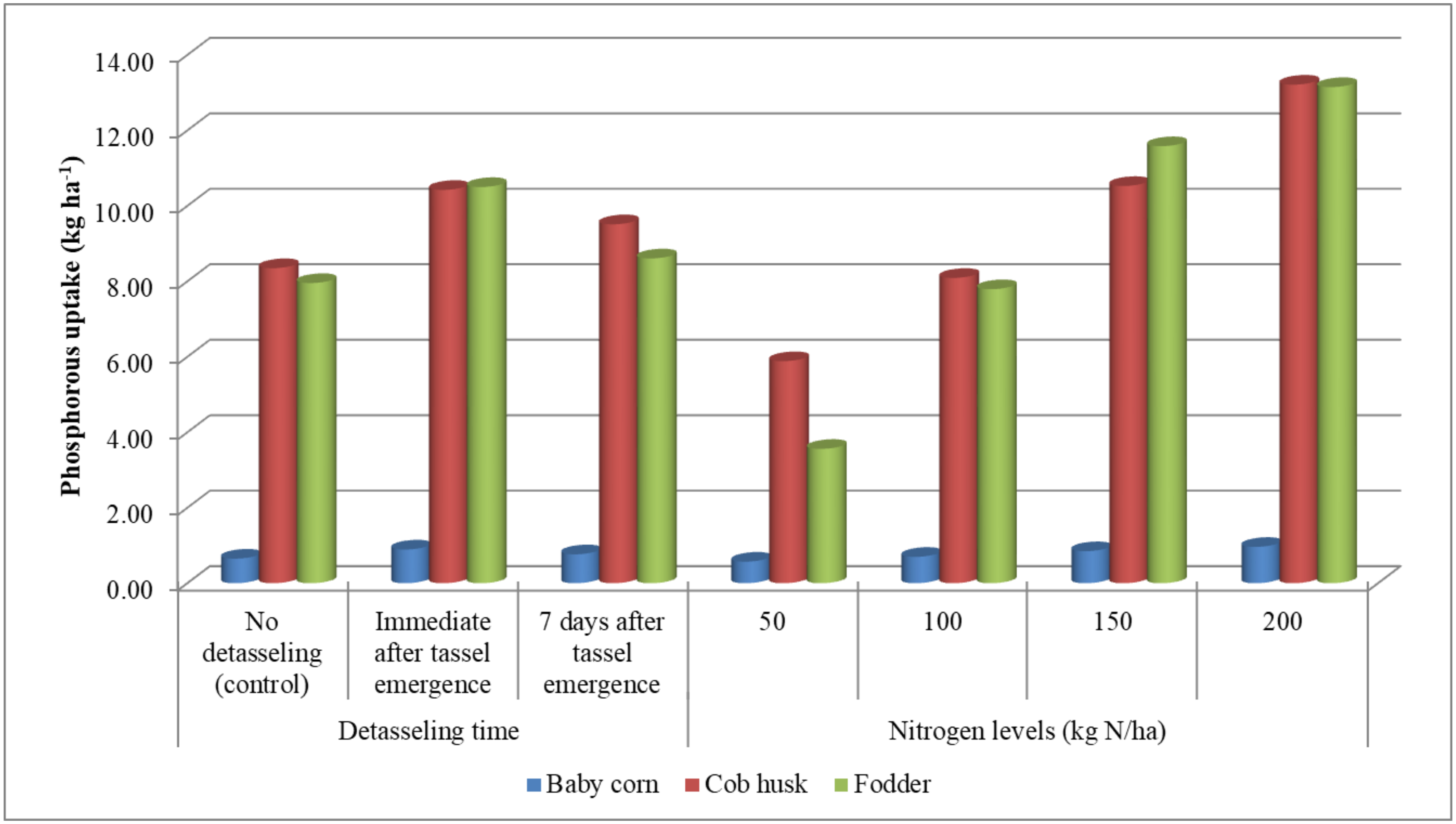


Fig: 4.19: Effect of nitrogen levels and detasseling time on potassium content (%) of baby corn, cob husk and fodder of winter baby corn

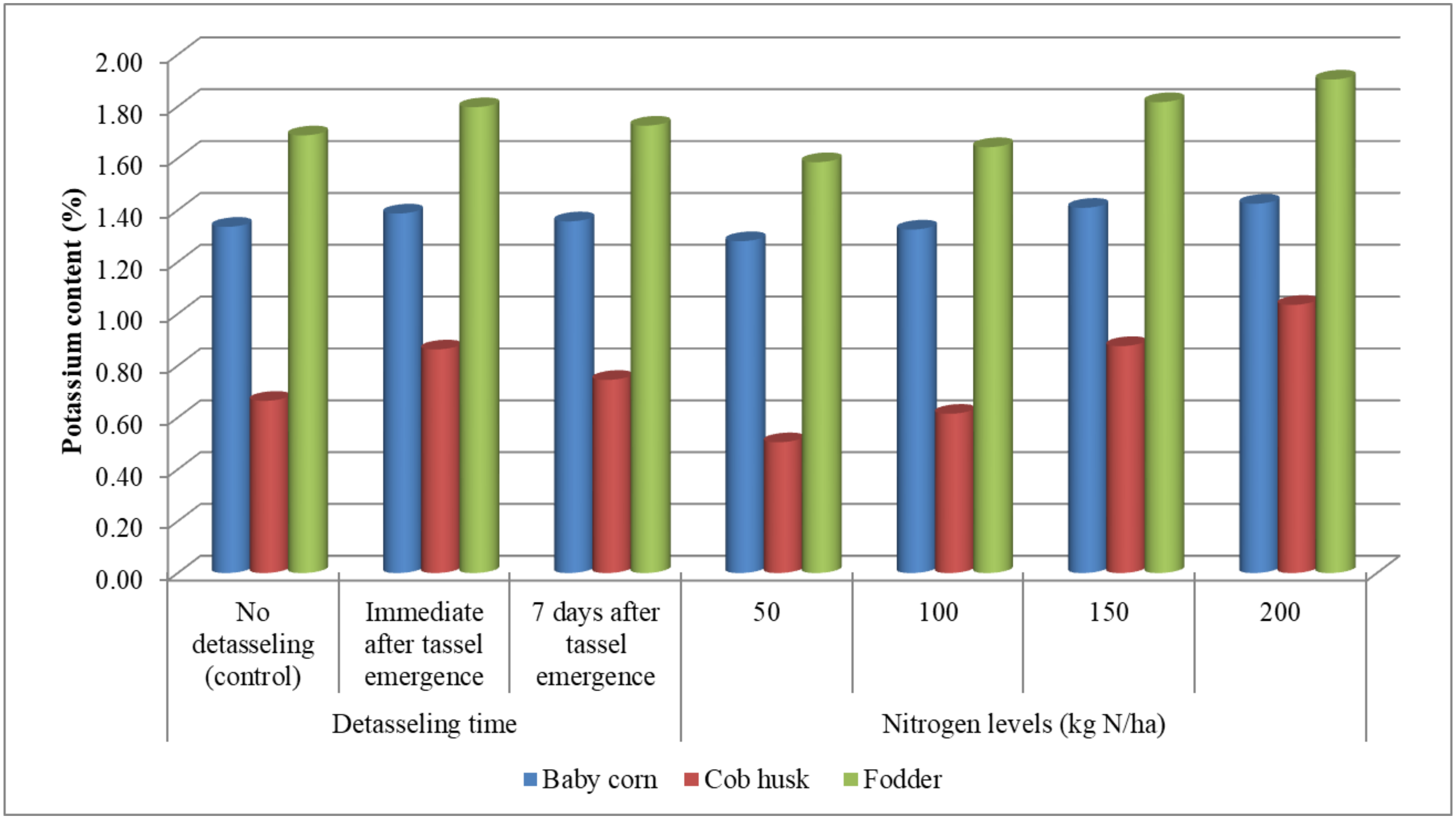


Fig: 4.20: Effect of nitrogen levels and detasseling time on potassium uptake (kg ha^{-1}) of baby corn, cob husk and fodder of winter baby corn

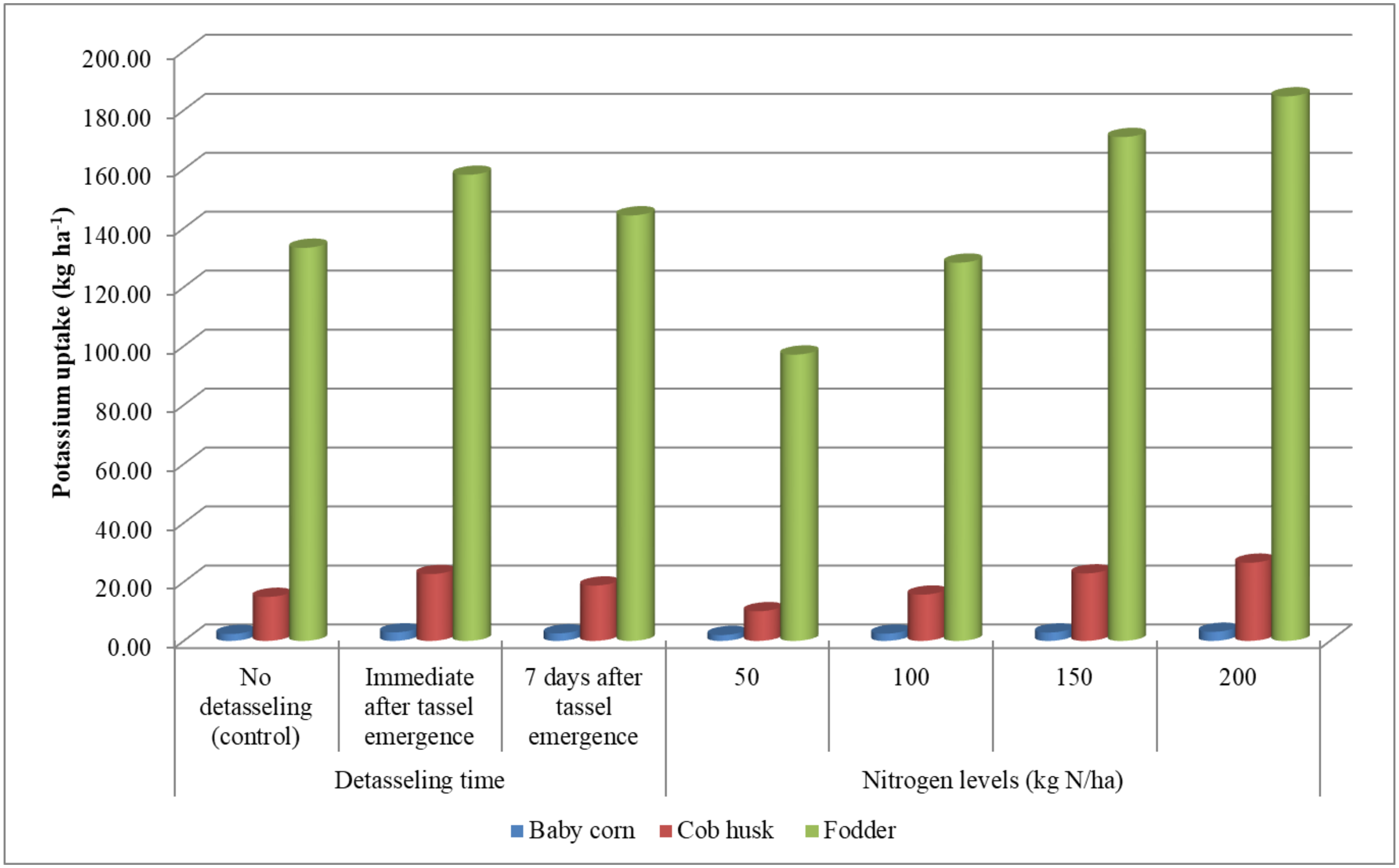


Fig: 4.21: Effect of nitrogen levels and detasseling time on protein content (%) of baby corn, cob husk and fodder of winter baby corn

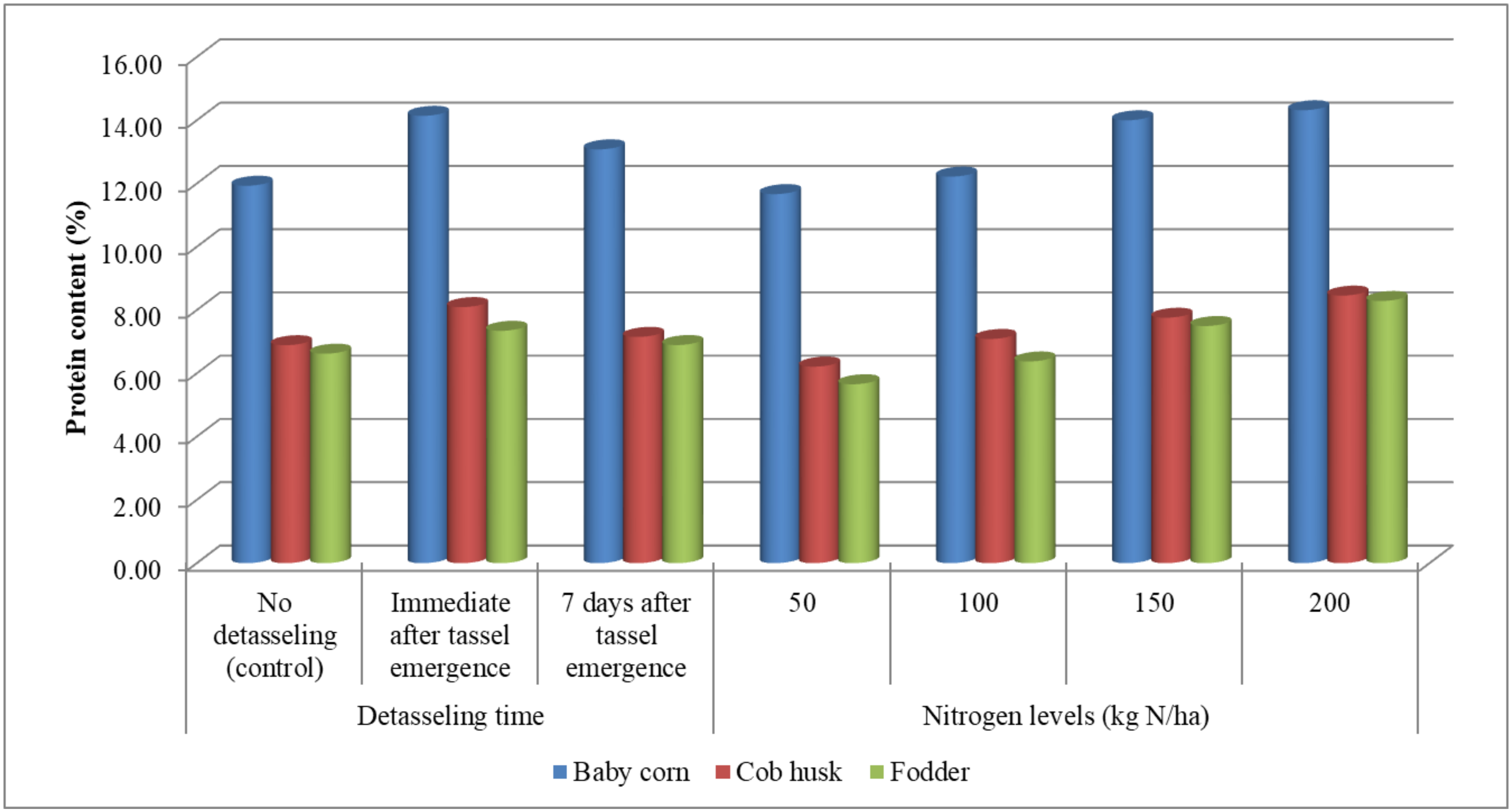


Fig: 4.22: Effect of nitrogen levels and detasseling time on protein uptake (kg ha^{-1}) of baby corn, cob husk and fodder of winter baby corn

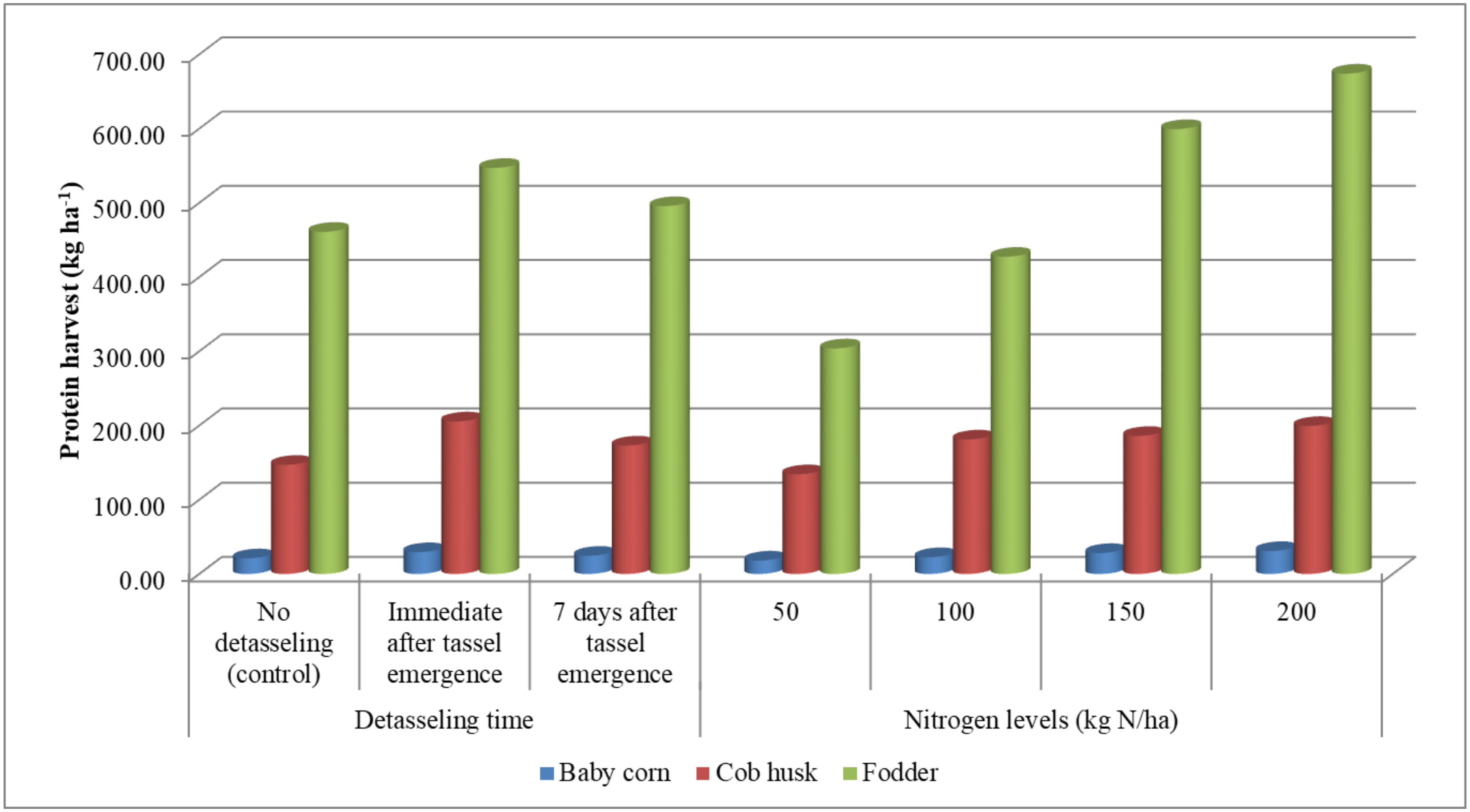


Fig: 4.23: Effect of nitrogen levels and detasseling time on available soil nutrients (kg ha^{-1}) of winter baby corn

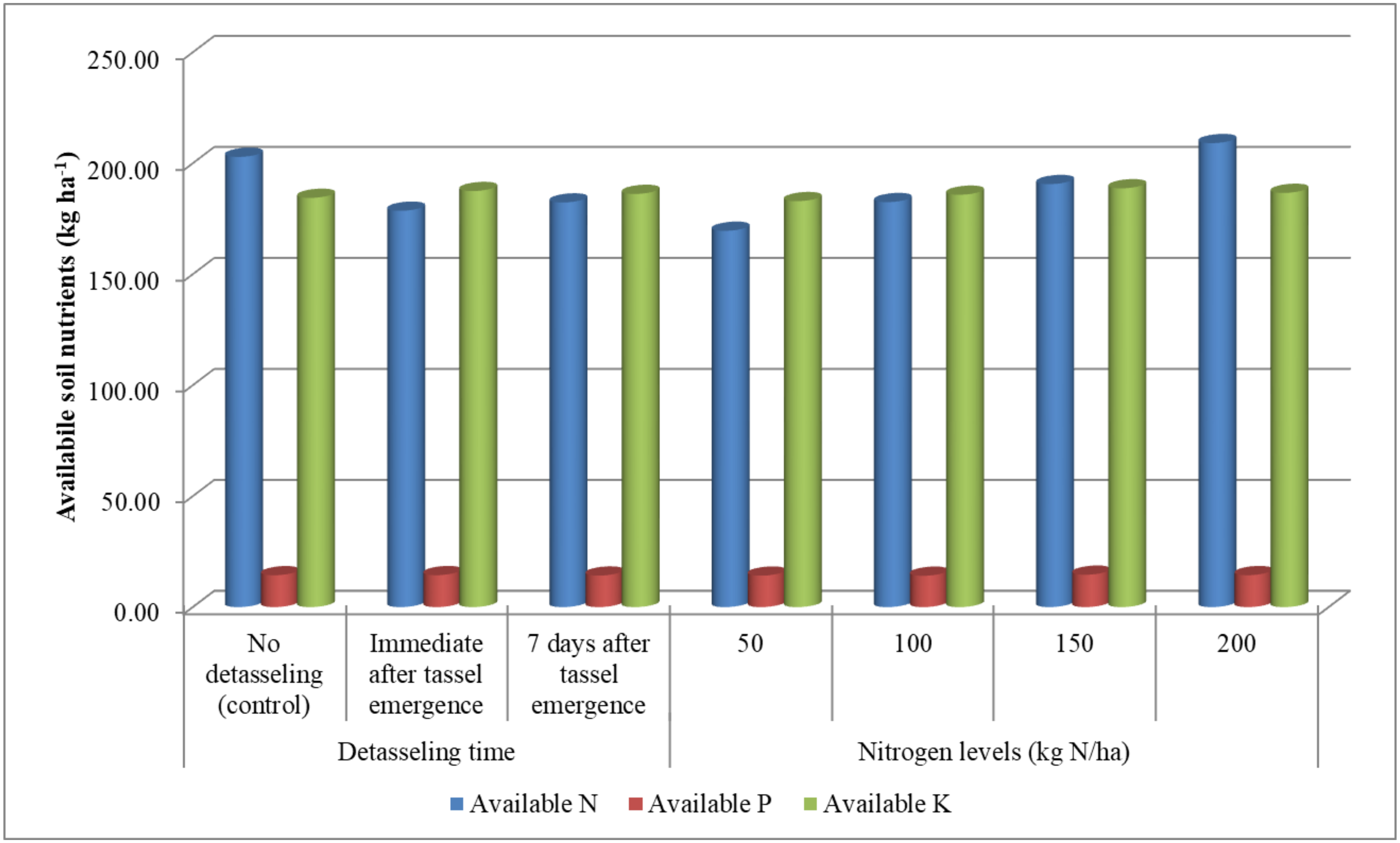


Fig: 4.24: Effect of nitrogen levels and detasseling time on total carbohydrates (%), starch (%) and total soluble sugars (%) of winter baby corn

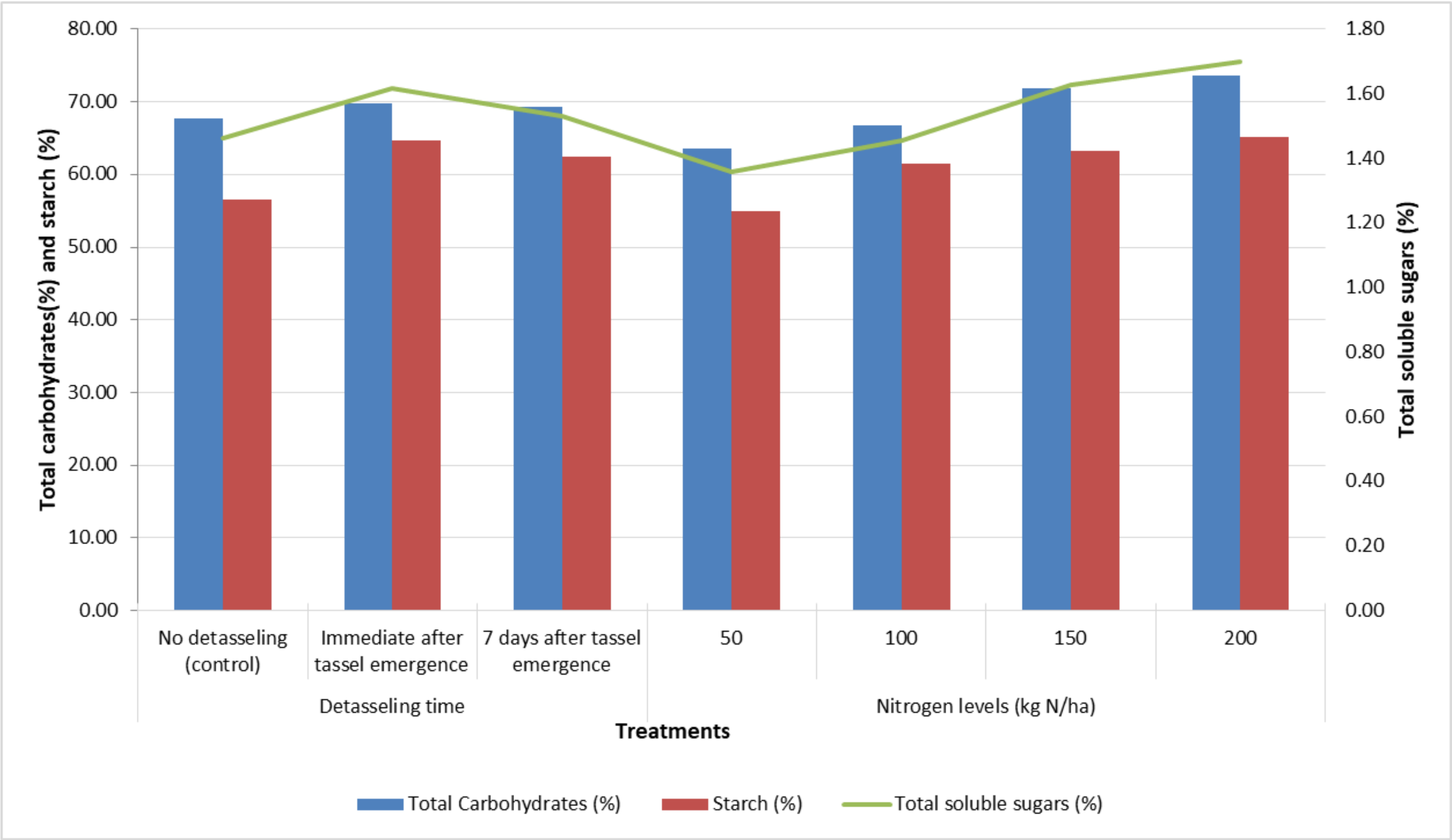


Fig: 4.25: Effect of nitrogen levels and detasseling time on economics of winter baby corn

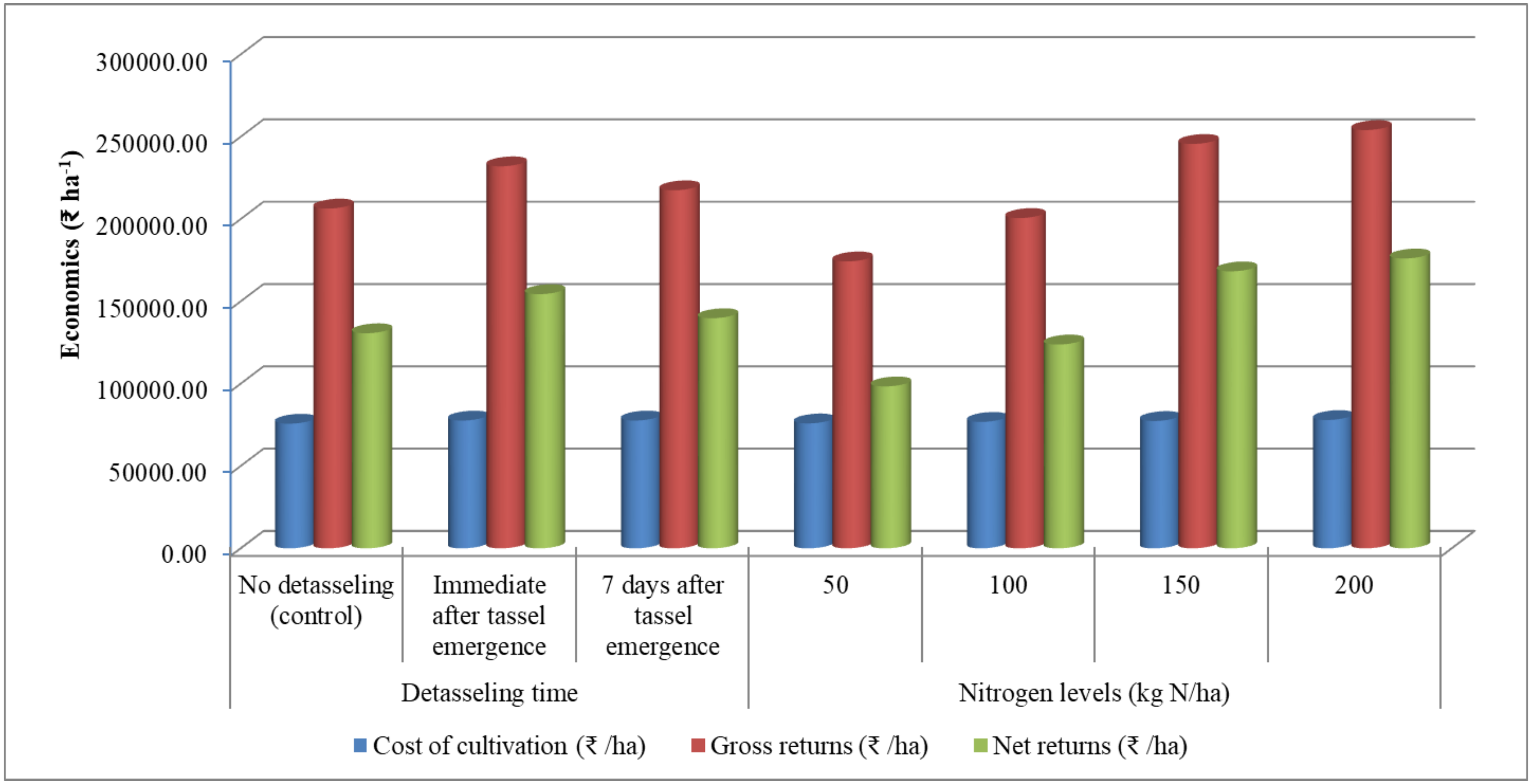


Plate 1: Supervision of experimental field

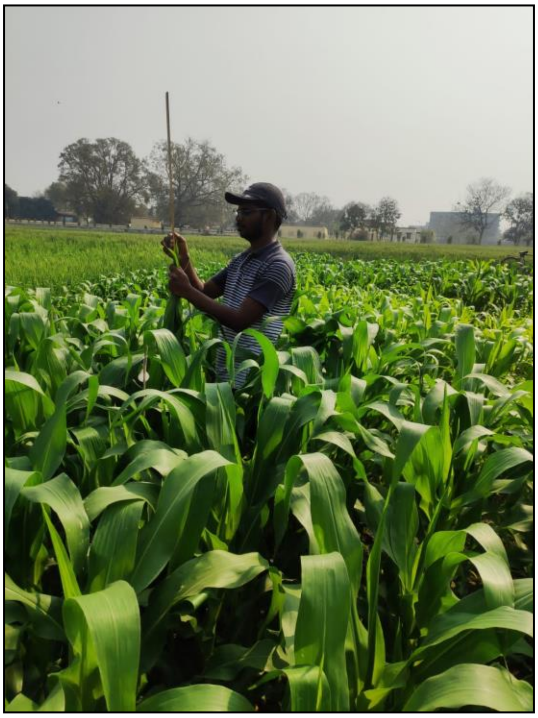


Plate 2: Biometric observations during field experimentation

Baby corn crop at 30 DAS

Baby corn crop at 60 DAS

Baby corn crop at 90 DAS

Baby corn crop at harvest

Plate 3: Different growth stages of winter baby corn

Earthing up operation

1st split application of urea

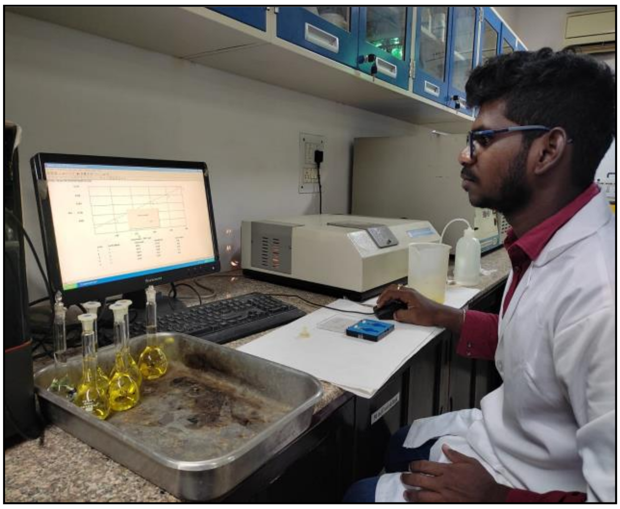
2nd split application of urea

Detasseling operation

Plate 4: Agronomic practices during field experimentation

Estimation of Nitrogen by modified Kjeldahl unit

Potassium analysis by flame photometer



Phosphorous analysis by spectrophotometer

Analysis of starch, total soluble sugars and total carbohydrates

Plate 5: Quality parameters analysis of winter baby corn in agronomy laboratory

Baby corn: (Application of 200 kg N ha^{-1} + detasseling immediately after tassel emergence)

Plate: 6. Baby cobs: (treatment 200 kg N ha^{-1} + detasseling immediately after tassel emergence)

Chapter V

DISCUSSION

Crop growth and development was primarily influenced by the physical, chemical and biological properties of soil, as well as environmental, genetic and cultural factors in field conditions. The primary objective of crop production is to get maximum production at minimum cost. In this chapter, an attempt has been made to discuss the important experimental findings recorded during the experimentation to offer as many supportive explanations and evidence to the findings in terms of the "cause" and "effect" relationship as possible. Before discussion ofthe experimental results, it is worth to know that the soil of the experimental field was sandy clay loam in texture, neutral in reaction and also having low organic carbon, low available nitrogen and medium in available P and K.

To diversify the crop ecosystem and increase farmer income, maize crop is grown as a vegetable *i.e*. baby corn. Generally, the highest yield of baby corn is influenced by several factors *viz*. the genetic potential of variety, local weather, soil conditions and nutrient status of soil and is also influenced by several biotic and abiotic factors. Baby corn is nitrogen responsive crop which requires ample supply of nitrogen because of high plant density. Increase in the baby corn production largely depends on increase in the levels of nitrogen to produce higher economic yield (Dawadi and Sah, 2012). Application of nitrogen in split doses at various growth stages significantly increases the yields due to efficient utilization of nitrogen and reduction in the leaching and volatilization losses (Neupane *et al*., 2017).

Baby corn production and quality may influenced by the detasseling operation; an important practice to increase the yields. Detasseling reduces the nutritional competition between the ear and tassel and also lead efficient utilization of solar radiation by flag leaves. This practice helps to translocate the photosynthates from source to sink results an increase in the baby corn production (Moreira *et al*., 2010).

Considering the facts mentioned above, the planned study on "**Effect of nitrogen levels and detasseling time on growth, yield and quality of winter baby corn (*Zea mays*. L)"** was conducted during the winter season of 2021-2022 at Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh (India).

5.1 Effect of weather conditions

Among various factors that influences the crop growth and development, climatic factors of a particular location are more prominent. Optimal weather parameters that are correlated with crop phenological stages during the growing season which improve crop performance. Hence, weather conditions prevailed during the experimentation was studied and various weather parameters (temperature, rainfall, relative humidity, sunshine duration and evaporation) recorded are presented in Table 3.1 and illustrated in Fig. 3.1.

To exploit the genetic potential of any crop particular cardinal points of weather parameters are important for better growth and development, however, if any fluctuations or deviation from optimum conditions, significantly affect the plant growth and development and finally, will affect the economic product. Baby corn experimental crop was sown during the winter season (last week of November). The initial growth of the crop was slow due to the lower temperatures recorded in the eastern region of Uttar Pradesh. However, during the harvest period, the highest temperature recorded which highly influenced the crop yield during the experimental period. Due to high temperature, more evaporation losses and crop demand for frequent irrigations occured during the reproductive stage. Similarly, bright sunshine hours were less during the initial crop growth but it increased from February till harvest which played major role in the photosynthetic efficiency of the crop.

5.2 Effect of detasseling time on baby corn

5.2.1 Effect of detasseling time on growth parameters of baby corn

Growth parameters of baby corn (plant height, number of leaves plant^{-1}, dry matter accumulation g plant^{-1}, LAI and SPAD values) has not shown significant variation due to detasseling time during at all the growth stages (Table 4.1.1 to 4.1.5). At harvest, plant height, number of leaves plant^{-1} and dry matter accumulation plant^{-1} recorded highest values but could not touch the level of significance. At harvest, the plant height increased due to detasseling immediately after tassel emergence may be due to the internodal elongation of baby corn.

5.2.2 Effect of detasseling time on yield and yield attributes of baby corn

The experimental results related to the yield and yield attributes *viz.* final plant population ha^{-1}, barrenness (%), number of barren plants ha^{-1}, days to 50% silk emergence, days to initiation of baby cob harvest, period of harvest, number of baby cobs plant^{-1}, baby corn length, baby corn girth, baby cob weight, baby corn weight, baby cob: baby corn ratio, baby cob yield (kg ha^{-1}), baby corn yield (kg ha^{-1}), fodder yield (t ha^{-1}) and picking wise baby cob and baby corn yield (kg ha^{-1}) exhibited significant variations due to the detasseling time treatments (Table 4.1.6 to 4.1.13).

The data shows that the final plant population was comparatively lower than the initial plant population but a uniform plant population was maintained during the experimentation. Variation in the final plant population was found non-significant due to detasseling time. Similarly, the number of barren plants (ha^{-1}) and barrenness (%) exhibited non-significant variation due to the detasseling time treatments though recorded highest values at 7 days after the tassel emergence (D_3) followed by detasseling after the emergence of tassel (D_2).

The lesser number of days required for initiation of baby cob harvest with the treatment detasseling after the tassel emergence (D_2) followed by 7 days after emergence of tassel (D_3). Data showed that days to initiation of baby cob harvest could not differ significantly due to detasseling time. Fifty per cent silk emergence of baby corn was also not influenced significantly due to detasseling time. Detasseling immediately after the emergence of tassel (D_2) took less number of days to reach the 50% silk emergence of baby corn than detasseling at 7 days after emergence of the tassel. However, no detasseling (D_1) took highest number of days to reach 50% silk emergence of baby cob. The data about days to initiation of baby cob harvest and 50% silk emergence of baby cob are presented in Table 4.1.7.

Detasseling after tassel emergence (D_2) took maximum number of days to harvest baby corn but was found at par with detasseling at 7 days after tassel emergence (D_3). This might be due to the more number of pickings due to the early detasseling. The number of baby cobs plant^{-1} was recorded significantly highest with the application of treatment detasseling after tassel emergence (D_2) which was found at par with the detasseling at 7 days after tassel emergence (D_3). Significantly less number of baby cobs plant^{-1} were noted with no detasseling (control). The data related to the number of days to harvest and the number of baby cobs plant^{-1} was presented in Table 4.1.8. These results confirmed the findings of Sahoo and Panda (2001), Moreira *et al*. (2010), Sammauria *et al*. (2019) and Irfanullah *et al*. (2017).

Baby corn length and girth were significantly highest with the treatment detasseling time after tassel emergence (D_2) which found statistically at par with detasseling time at 7 days after tassel emergence (Table 4.1.9). This might be due to the less competition for nutrients between the tassel and ear due to the removal of the tassel immediately after emergence and also flag leaf received the maximum solar radiation for its photosynthetic activity. However, no detasseling (D_1) claimed lowest baby corn length and girth. These results during experimentation were supported by the findings of Hunter *et al*. (1969).

Baby cob and corn weight significantly differed with treatment detasseling after tassel emergence (D_2) which was superior with no detasseling, but observed statistically at par with detasseling at 7 days after emergence (D_3). Detasseling immediately after tassel emergence recorded narrow baby cob: baby corn ratio compared with no detasseling (Table 4.1.10). This may be due to greater baby cob and baby corn weight noted due to detasseling after tassel emergence resulted narrow baby cob: baby corn ratio. Baby cob: baby corn ratio was not affected due to detasseling time and found non-significant. The results agreed with the work reported by Sahoo and Panda (2001) and Moreira *et al*. (2010).

The statistically analyzed data showed that baby cob and baby corn yield was significantly highest with the treatment detasseling after tassel emergence (D_2) followed by detasseling at 7 days after tassel emergence (D_3) and the lowest baby cob and baby corn yield was recorded with no detasseling (D_1). This might be due to the fact that after removal of tassel; all the nutrients and photosynthates translocated to the economic parts and also increased radiant flux to the leaves. Fodder yield of baby corn was also highest with detasseling after tassel emergence followed by 7 days after tassel emergence, however, the lowest fodder yield was recorded with no detasseling. This may be due to the higher plant height but there was no effect of detasseling time. Picking wise baby cob and baby corn yield was significantly highest with detasseling after tassel emergence followed by detasseling at 7 days after tassel emergence and lowest with no detasseling. Among the various pickings of baby corn, II^{nd} picking gave highest baby cob and baby corn yield followed by I^{st}, III^{rd} and IV^{th} picking. The result observed during experimentation was supported by Sammauria *et al*. (2019), Irfanullah *et al*. (2017), Moreira *et al*. (2010), Sahoo and Panda (2001) and Hunter *et. al* (1969). Among the various treatments of detasseling time, detasseling after tassel emergence performed better yields than the rest of the two treatments.

5.2.3 Effect of detasseling time on the quality of baby corn

Protein content in baby corn, cob husk and fodder and protein harvest by baby corn, cob husk and fodder found significantly varied due to the detasseling time. Protein content and protein harvest of baby corn, cob husk and fodder were significantly highest with the treatment detasseling after tassel emergence (D_2) followed by detasseling at 7 days after tassel emergence (D_3) and lowest values noted with no detasseling (D_1). The increase in protein content was mainly due to an increase in nitrogen percentage and nitrogen uptake by baby corn. Application of detasseling time treatments caused significant variation on total soluble sugars, starch and total carbohydrates content (%). Maximum and minimum values of quality parameters registered with detasseling after tassel emergence and no detasseling, respectively. The higher values recorded due to detasseling after tassel emergence may be due to all the nutrients translocated to the economic part and also because of enhanced photosynthetic activity.

5.2.4 Effect of detasseling time on nutrient content and uptake by baby corn

Nutrients (N, P and K) content of baby corn, cob husk and green fodder showed significant variation due to detasseling time during the experimental period. Significantly highest N, P and K values of baby corn, cob husk and green fodder were observed with detasseling after tassel emergence (D_2) which was statistically at par detasseling at 7 days after tassel emergence (D_3) and the lowest values were recorded with no detasseling (D_1). Detasseling after tassel emergence recorded highest nutrient uptake by baby corn, cob husk, fodder yield and total uptake followed by detasseling at 7 days after tassel emergence and no detasseling. Nutrient content and nutrient uptake of baby corn, cob husk and green fodder were highest due to detasseling after tassel emergence may be due to the rapid translocation of nutrients into the baby cobs. Similar findings were suggested by Patel *et al*. (2015) and Singh (2010).

5.2.5 Effect of detasseling time on economics of baby corn

The highest cost of cultivation observed with detasseling after tassel emergence (D_2) and 7 days after tassel emergence (D_3) compared to no detasseling (D_1) because of labor cost involved in the detasseling operation. Maximum gross returns were recorded with detasseling after tassel emergence followed by 7 days after tassel emergence and minimum gross returns were noticed with no detasseling because this treatment recorded the lowest yields. Maximum and minimum net returns and benefit: cost ratio of baby corn also noticed with detasseling after tassel emergence and no detasseling, respectively because detasseling after tassel emergence produced the highest yields. Similar results were registered by Sammauria *et al*. (2019) and Sahoo and Panda (2001).

5.3 Effect of nitrogen levels on baby corn

5.3.1 Effect of nitrogen levels on growth attributes of baby corn

Growth attributes of winter baby corn *viz.* plant height, number of leaves plant^{-1}, dry matter accumulation (g plant^{-1}), leaf area index and chlorophyll content (SPAD value) were found significantly varied due to the nitrogen levels at all growth stages except 30 DAS. At this stage plant height, number of leaves plant^{-1} and dry matter accumulation plant^{-1} (g) observed non-significant (Table 41.1 to 4.1.5).

The initial plant population of baby corn exhibited non-significant variations due to nitrogen levels. During the initial period of crop, plant population was maintained uniformly leads to good crop establishment (Table 4.1.6). Similar findings were reported by Thakur and Sharma (1999).

The plant height of baby corn showed significant variation due to nitrogen levels at 60, 90 DAS and at harvest, however, non-significant variations recorded at 30 DAS. The highest plant height was recorded at 60, 90 and at harvest with the application of 200 kg N ha^{-1} (N_4) found superior over the 50 kg N ha^{-1} (N_1) and 100 kg N ha^{-1} (N_2), but observed at par with 150 kg N ha^{-1} (N_3). The lowest plant height was recorded with 50 kg N ha^{-1} followed by 100 kg N ha^{-1}. The plant height increased with the advancement of crop growth stages. This might be due to higher nitrogen uptake increased the cell division and cell elongation, nucleus formation as well as green foliage, photosynthetic activity, and also encouraged shoot growth. At 30 DAS, the highest plant height was observed with 150 kg N ha^{-1} but was not affected due to nitrogen levels because of slow growth noticed due to low temperatures. The similar finding also reported by Ramachandiran and Pazhanivelan (2016), Dawadi and Sah (2012), Singh *et al*. (2009), Roy *et al*. (2019), Dar *et al*. (2014), Bindani *et al*. (2007), Thakur and Sharma (1999).

The number of leaves plant^{-1} were significantly varied due to nitrogen levels at all growth stages except at 30 DAS. The highest number of leaves plant^{-1} was recorded with the application of 200 kg N ha^{-1} (N_4) followed by 150 kg N ha^{-1} (N_3) and the lowest number of leaves plant^{-1} was noted with the 50 kg N ha^{-1} (N_1) and 100 kg N ha^{-1} (N_2) during all growth stages of baby corn. The number of leaves $plant^{-1}$ increases with the crop growth stages. Das *et al*. (2008) and Thakur *et al*. (1997) also reported similar findings.

Various nitrogen levels to baby corn significantly affected the dry matter accumulation (g $plant^{-1}$) at all growth stages except 30 DAS. The highest dry matter accumulation was observed with the application of 200 kg N ha^{-1} noted superior over the 50 kg N ha^{-1} (N_1) and 100 kg N ha^{-1} (N_2), but was found at par with 150 kg N ha^{-1} (N_3) at all growth stages of baby corn. Dry matter accumulation $plant^{-1}$ increased with the crop advancement stages. This may be due to the increased photosynthetic activity because of higher nitrogen availability, less interspecific competition between the rows for intercepting solar radiation and also nitrogen was involved in the chlorophyll formation. Singh *et al*. (2009), Bindani *et al*. (2007), Thakur and Sharma (1999) Sobhana *et al*. (2012) found similar evidences.

The LAI of baby corn significantly varied due to nitrogen levels at 40, 60 and 90 DAS. The leaf area index was significantly highest with the application of 200 kg N ha^{-1} (N_4) observed at par with 150 kg N ha^{-1} (N_3). The lowest LAI was recorded with 50 kg N ha^{-1} (N_1) compared to the 100 kg N ha^{-1} (N_2) during experimentation. The LAI increased with crop growth stages because of the higher number of leaves and leaf area recorded and also the optimum plant population intercepted more solar radiation. The similar evidence supported by Bindani *et al.* (2007), Ramachandiran and Pazhanivelan (2016), Dar *et al*. (2014), Singh *et al*. (2009), Sobhana *et al*. (2012).

Significant variation in chlorophyll content (SPAD value) was recorded due to various nitrogen levels at all growth stages during experimentation. The highest SPAD values were observed with the application of 200 kg N ha^{-1} (N_4) followed by 150 kg N ha^{-1} (N_3) and the lowest values were recorded with 50 kg N ha^{-1} (N_1) compared to the 100 kg N ha^{-1} (N_2). The chlorophyll content (SPAD values) increased with an increase in the levels of nitrogen due to its higher mobility in soil and plant; it increased the leaf chlorophyll content in turn to the greenness of the leaves with the advancement of crop growth stages. Ramachandiran and Pazhanivelan (2016), Singh *et al*. (2009), Ali and Anjum (2017), and Joshi *et al*. (2014) also supported the experimental results.

5.3.2 Effect of nitrogen levels on yield attributes and yield of baby corn

The effect of nitrogen levels on yield and yield attributes of winter baby corn *viz.* final plant population ha^{-1}, barrenness (%), number of barren plants ha^{-1}, days to 50% silk emergence, days to initiation of baby cob harvest, period of harvest, number of baby cobs $plant^{-1}$, baby corn length, baby corn girth, baby cob weight, baby corn weight, baby cob: baby corn ratio, baby cob yield (kg ha^{-1}), baby corn yield (kg ha^{-1}), fodder yield (t ha^{-1}) and picking wise baby cob and baby corn yield (kg ha^{-1}) varied significantly due to the nitrogen levels (Table 4.1.6 to 4.1.13).

The final plant population ha^{-1}, barren plants ha^{-1} and bareness (%) showed non-significant variation due to different nitrogen levels (Table 4.1.6). During experimentation, a homogenous plant population was maintained which results in maximum yields and the lowest number of barren plants ha^{-1}, barrenness (%) observed with the application of 200 kg N ha^{-1} (N_4) due to ample supply of nitrogen to the crop for its metabolic activity. Thakur and Sharma (1999) and Singh *et al*. (2009) reported similar findings.

Significant variation in 50% silk emergence and days to initiation of baby cob harvest recorded due to nitrogen levels (Table 4.1.7). The maximum number of days taken for 50% silk emergence and days to initiation of baby cob harvest observed with the application of 50 kg N ha^{-1} (N_1) and minimum values were recorded with the application of 200 kg N ha^{-1} (N_4). Higher levels of nitrogen caused the rapid crop growth and the crop took less number of days to reach 50% silk emergence and days to initiation of baby cob harvest.

The period of harvest and number of baby cobs $plant^{-1}$ exhibited significant variation due to nitrogen levels (Table 4.1.8). The maximum period of harvest and baby cobs $plant^{-1}$ was observed with the addition nitrogen @ 200 kg ha^{-1} superior than its lower doses (50 and 100 kg N ha^{-1}) but found equal to use of 150 kg N ha^{-1} Similar findings were supported by Das *et al*. (2008), Roy *et al*. (2019), Srichandan and

Mangaraj (2015), Singh *et al*. (2009), Sobhana *et al*. (2012), Pal *et al*. (2017), Thakur and Sharma (1999) and Sahoo (2011).

The baby corn length and girth showd significant variation due to the nitrogen levels (Table 4.1.9). Application of 200 kg N ha^{-1} (N_4) registered significantly highest baby corn length and girth over the 50 kg N ha^{-1} (N_1) and 100 kg N ha^{-1} (N_2), however, it was found at par with 150 kg N ha^{-1} (N_3). The baby corn length and girth were maximum with high level of nitrogen due to increased supply of nitrogen and more translocation to the economic part. Experiment results confined by Ramachandiran and Pazhanivelan (2016), Das *et al*. (2008), Singh *et al*. (2009), Bindani *et al*. (2007), Thakur and Sharma (1999), Pal *et al*. (2017), Kar *et al*. (2006) and Sahoo (2011).

Various nitrogen levels to baby corn resulted in significant variation in the baby cob and baby corn weight during the experimentation. The baby cob: baby corn ratio was found unaffected due to the nitrogen levels (Table 4.1.10). The highest baby cob and baby corn weight was recorded with the application of 200 kg N ha^{-1} followed by 150 kg N ha^{-1} compared with the 50 kg N ha^{-1} and 100 kg N ha^{-1}. Due to the highest baby cob and baby corn weight, the baby cob: baby corn ratio was narrowed. These results are supported by Roy *et al*. (2019), Ramachandiran and Pazhanivelan (2016), Srichandan and Mangaraj (2015), Das *et al*. (2008), Singh *et al*. (2009) and Thakur and Sharma (1999).

The baby cob, corn and fodder yields showed significant variation due to the various nitrogen levels and picking-wise yields also exhibited significant variations (Table 4.1.11 to 4.1.13). The highest baby cob, corn and fodder yields were recorded with the application of 200 kg N ha^{-1} (N_4) which was superior to the 50 kg N ha^{-1} (N_1) and 100 kg N ha^{-1} (N_2), it was observed at par with the application of 150 kg N ha^{-1}. The highest yields of baby corn increased with the levels of nitrogen. This may be due to the improvement in the growth and yield attributes that influenced the yield of baby corn favourably. The results are supported by the findings of Sahoo (2011), Kar *et al*. (2006), Pal *et al*. (2017), Sahoo and Panda (1999), Sobhana *et al*. (2012), Thakur and Sharma (1999), Bindani *et al*. (2007), Singh *et al*. (2009), Srichandan and Mangaraj

(2015), Dar *et al.* (2014), Ramachandiran and Pazhanivelan (2016), Roy *et al*. (2019), Asaduzzaman *et al*. (2014), Sharma *et al*. (2018), Dawadi and Sah (2012), Das *et al*. (2008) and Ali and Anjum (2017).

The picking wise baby corn yield was highest with the application of 200 kg N ha^{-1} followed by 150 kg N ha^{-1} and the lowest values were observed with the application of 50 kg N ha^{-1} and 100 kg N ha^{-1}. During experimentation, IInd picking was recorded highest yield followed by Ist and gradually decreased from IIIrd and IVth picking. The baby cob, corn and fodder yield observed with nitrogen levels decreased in trend of $N_4 > N_3 > N_2 > N_1$.

5.3.3 Effect of nitrogen levels on quality parameters of baby corn

The quality parameters of baby corn include protein (%), total soluble sugars, starch and total carbohydrates indicated significant variations with nitrogen levels (Table 4.1.17 and 4.1.18). Application 200 kg N ha^{-1} recorded significantly highest protein (%), protein harvest in baby corn, cob husk and fodder over the treatment 50 kg N ha^{-1} and 100 kg N ha^{-1}, but it was found at par with the application of 150 kg N ha^{-1}. The protein (%) and protein harvest of baby corn, cob husk and fodder found highest with the high level of nitrogen supply may be due to increased uptake of nitrogen and to the maximum total N content accumulated an extended benefit with congenial biochemical relations at higher N. Similar results reported by Dar *et al*. (2014), Muthukumar *et al*. (2005), Ramachandrappa *et al*. (2004).

5.3.4 Effect of nitrogen levels on nutrient content and their uptake of baby corn

The N, P, K content (%) and their uptake (kg ha^{-1}) in baby corn, cob husk and fodder and total uptake of bay corn were significantly affected due to the various nitrogen levels during the experimentation (Table 4.1.14 to 4.1.16). The N, P, K content (%) and their uptake were recorded significantly highest with the application of 200 kg N ha^{-1} (N_4) and lowest with 50 kg N ha^{-1} (N_1) and 100 kg N ha^{-1} (N_2), however, treatment 150 kg N ha^{-1} (N_3) observed at par with N_4. These results may be due to the highest nutrient use and high mobility of N in soil and plant; caused rapid translocation to the economic part. Similar results were supported by Sobhana *et al*. (2012), Kar *et al.* (2006), Dar *et al*. (2014) and Patel *et al.* (2015).

5.3.5 Effect of nitrogen levels on the economics of baby corn

The highest cost of cultivation involved with the application of treatment of 200 kg N ha^{-1} followed by 150 kg N ha^{-1} because involved the cost of fertilizers. Gross returns, net returns and benefit: cost ratio was highest with the application of 200 kg N ha^{-1} and lowest with the 50 kg N ha^{-1} and 100 kg N ha^{-1}, but the treatment of 150 kg N ha^{-1} observed at par. The gross returns, net returns and benefit: cost ratio increased with high level of nitrogen. This might be due to the increase in the baby corn yield with the high levels of nitrogen. These findings are supported by Roy *et al*. (2019), Ramachandiran and Pazhanivelan (2016), Dar *et al*. (2014), Das *et al*. (2008), Bindani *et al*. (2007), Thakur and Sharma (1999), Sobhana *et al*. (2012), Sahoo and Panda (1999), Pal *et al*. (2017), Kar *et al.* (2006), and Sahoo (2011).

5.4 Effect of treatments on available nutrient status of soil

The available nitrogen in the soil was found to vary significantly due to the detasseling time and nitrogen levels during the experimentation. The highest available soil nitrogen noticed with the treatment no detasseling and 200 kg N ha^{-1} and the lowest values were observed with the detasseling after tassel emergence and 50 kg N ha^{-1}. The available P and K in soil failed to show any significant change since equal dose applied to all the treatments.

Chapter VI

SUMMARY AND CONCLUSION

Baby corn (*Zea mays* L.) is an important crop grown for vegetable purpose and enhances farmer's income. Baby corn is an unfertilized dehusked cob harvested at 2-3 days after silk emergence useful in crop diversification, fast-growing, short duration crop with high yield potential, and wider adaptability. It is highly nutritive, free from cholesterol, low calories and high fiber content. This crop provides higher return per unit area and helps in employment generation in rural areas.

Baby corn is highly responsive to nitrogen fertilizer, and requires more nitrogen for its growth and productivity. It is an exhaustive crop requires nitrogen in high quantity to harvest greater yields and green fodder. Detasseling is one of the most important practices in baby corn production. This practice reduces competition between the tassel and silk for nutrients and enhances the quantity and quality of the product. To optimize the nitrogen level for winter season baby corn is necessary. No work has been done so far to investigate the effect of detasseling time on baby corn. Therefore, it is necessary to identify the nitrogen levels in combination with appropriate detasseling time for winter baby corn. There is a need to focus on such production technologies of baby corn to increase the yield and economic returns.

Baby corn is a high yield potential crop in winter season and its cultivation is relatively new in this region thus requires more research to identify the technologies especially on nitrogen levels and detasseling time to enhance the growth, yield, and quality. After review of above facts, the planned study on "**Effect of nitrogen levels and detasseling time on growth, yield and quality of winter baby corn (*Zea mays* L.)**" was undertaken with the following objectives:

- To ascertain the impact of nitrogen levels on growth and yield of winter season baby corn.
- To find out the effect of treatments on the nutrient uptake and quality of winter season baby corn.

- To analyze the economic viability of the treatments.

A field experiment was conducted during winter season of 2021-2022 at Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh. The climatic condition of this region falls under a subtropical climate with hot summers and cold winters. The soil of the experimental field was sandy clay loam, neutral in reaction (pH 7.3), having low organic carbon (0.33%), low available nitrogen (198.13 kg N ha^{-1}), medium in phosphorous (19.56 kg P_2O_5 ha^{-1}), and potassium (147.28 kg K_2O ha^{-1}). Factorial experiment was laid out in RCBD with a combination of two factors *i.e* three detasseling times (D_1: No detasseling (control), D_2: At tassel emergence, and D_3: 7 days after tassel emergence) and four nitrogen levels (N_1: 50 kg N ha^{-1}, N_2: 100 kg N ha^{-1}, N_3: 150 kg N ha^{-1}, N_4: 200 kg N ha^{-1}). A total of 12 treatments were tested in this experiment. Baby corn was sown on 27 November, 2021 adopting the seed rate of 40 kg ha^{-1} at a spacing of 40×20 cm. Recommended dose of nutrients *viz.* 75 kg P_2O_5, 60 kg K_2O, 40 kg S, and 10 kg Zn ha^{-1} was uniformly applied as basal to experimental plots. Nitrogen was applied in three splits *i.e.*50% as basal + 25% at knee-high stage + 25% at tassel emergence as per treatments. Urea, DAP, MOP, Gypsum and Zinc Sulphate were used as fertilizer sources. Standard methods and procedures were used for the collection of data, and analysis of data and plant materials.

Growth attributes *viz.* plant height (cm), number of leaves $plant^{-1}$, dry matter accumulation $plant^{-1}$, and chlorophyll content (SPAD value) were recorded at 30, 60, 90 DAS and at harvest. Leaf area index recorded at 40, 60 and 90 DAS. Initial and final plant population, barrenness (%), and barren plants ha^{-1} were recorded. Yield attributes *viz.* days to initiation of baby cob harvest, days to 50% silk emergence, period of harvest (days), number of baby cobs $plant^{-1}$, baby corn length (cm), baby corn girth (cm), baby cob and baby corn weight (g), baby cob: baby corn ratio, baby cob yield (kg ha^{-1}), baby corn yield (kg ha^{-1}), fodder yield (t ha^{-1}) and picking wise baby cob and corn yield (kg ha^{-1}) were recorded. Quality parameters of baby corn *viz.* N, P, K content (%) and their uptake by the plant (baby corn, cob husk, and green fodder) and protein content (%), protein harvest (kg ha^{-1}), total carbohydrates (%), total soluble sugars (%) and starch content (%) were analyzed. Finally, the economics of different treatments were worked out. The experimental findings presented and discussed in previous chapters are summarized below:

6.1 Effect of treatments on growth attributes

The growth attributes of baby corn *viz.* plant height, number of leaves plant^{-1}, dry matter accumulation, and chlorophyll content (SPAD values) at 30, 60, 90 DAS, and at harvest were found non-significant due to the detasseling time treatments during the experiment. Leaf area index also failed to show any significant variation at 40, 60 and 90 DAS. The initial plant population of baby corn did not reach to significant level due to the effect of detasseling time treatments.

Various nitrogen levels of baby corn showed significant variation on plant height, number of leaves plant^{-1}, dry matter accumulation g plant^{-1} at all growth stages except 30 DAS. Application of 200 kg N ha^{-1} (N_4) recorded significantly highest plant height, number of leaves plant^{-1}, and dry matter accumulation at all growth stages except at 30 DAS which was greater than the application of 50 kg N ha^{-1} and 100 kg N ha^{-1}, but it was observed at par with the 150 kg N ha^{-1}. Leaf area index also recorded significant variation due to nitrogen levels at 40, 60, and 90 DAS with the application of 200 kg N ha^{-1} and 150 kg N ha^{-1} found at par. Chlorophyll content (SPAD value) noted significant variation at all growth stages with the application of 200 kg N ha^{-1} when compared with the 50 kg N ha^{-1} and 100 kg N ha^{-1}, however, 150 kg N ha^{-1} was recorded at par. The initial plant population of baby corn was unaffected due to the various nitrogen levels during the experimentation.

6.2 Effect of treatments on yield attributes and yield

Detasseling time treatments studied in this study exhibited significant variation on yield and yield attributes of baby corn. The final plant population, barrenness (%), and barren plants ha^{-1} recorded non-significant variation due to the detasseling time treatments. Application of treatment detasseling after tassel emergence (D_2) registered significantly lowest days to initiation of baby cob harvest and also lowest days for 50% silk emergence compared to the no detasseling (D_1), but it was found at par with the detasseling at 7 days after tassel emergence (D_3). The period of harvest (days), no. of baby cobs plant^{-1}, baby corn length and girth, baby cob and baby corn weight registered significantly highest values with the treatment detasseling after tassel emergence which was superior to no detasseling, however, detasseling time 7 days after tassel emergence noted at par. Narrow baby cob: baby corn ratio was registered with the detasseling after tassel emergence. The baby cob and baby corn yield, and green fodder yields were significantly highest with the treatment detasseling after tassel emergence compared to no detasseling and it recorded at par with the detasseling at 7 days after tassel emergence. Out of four pickings, baby cob and corn yields increased up to IInd picking then decreased afterward.

Final plant population, barrenness (%), and barren plants ha^{-1} found non-significant due to the different nitrogen levels. Application of 200 kg N ha^{-1} recorded significantly lowest days for initiation of baby cob harvest and 50% silk emergence compared to the other treatments. Yield attributes *viz*. period of harvest (days), baby cobs plant^{-1}, baby corn length and girth, baby cob and baby corn weight were significantly higher with the application of 200 kg N ha^{-1} (N_4) followed by 150 kg N ha^{-1} (N_3), but the lowest values were recorded with the 50 kg N ha^{-1} (N_1) and 100 kg N ha^{-1} (N_2). Narrow baby cob: baby corn ratio registered with the 200 kg N ha^{-1} than other treatments. Baby cob and baby corn yield, and green fodder yields were significantly higher with the application of 200 kg N ha^{-1} than the rest of the treatments but at par with the 150 kg N ha^{-1}. The lowest values were registered with the 50 kg N ha^{-1} and 100 kg N ha^{-1}.

6.3 Effect of treatments on quality parameters

The investigation on detasseling time showed significant variation on the quality parameters *viz.* total carbohydrates, total soluble sugars, starch and protein content (%), and protein harvest. Application of treatment detasseling after tassel emergence gave significantly highest quality parameters than no detasseling (control) but noted at par with the detasseling at 7 days after tassel emergence.

The quality parameters of baby corn *viz.* total carbohydrates, total soluble sugars, starch and protein content (%) and protein harvest (kg ha^{-1}) recorded significant variations due to different nitrogen levels. Application of 200 kg N ha^{-1} registered significantly higher quality parameters than the rest of the treatments but found at par with the 150 kg N ha^{-1}.

6.4 Effect of treatments on nutrient content and their uptake

The nutrient content *viz.* N, P and K content (%) and their uptake of baby corn, cob husk, and green fodder were significantly highest with the treatment detasseling after tassel emergence than no detasseling (control) but at par with the detasseling time at 7 days after tassel emergence.

Application of various nitrogen levels had significant variation on the nutrient content and their uptake by baby corn, cob husk and green fodder. Application of 200 kg N ha^{-1} found significantly highest N, P and K content (%) and their uptake by baby corn, cob husk and fodder compared to the 50 kg N ha^{-1} and 100 kg N ha^{-1}, but at par with 150 kg N ha^{-1}.

6.5 Effect of treatments on available nutrient status of soil

Available nitrogen in the soil after harvest showed significant variation with detasseling and nitrogen level treatments. The available P and K in soil recorded non-significant variation with detasseling time and nitrogen levels.

6.6 Effect of treatments on economics

Economics of baby corn includes cost of cultivation, gross returns, net returns, and benefit: cost ratio as affected due to the detasseling time treatments. The highest cost of cultivation was observed with the detasseling after tassel emergence and 7 days after tassel emergence and the lowest cost involved in no detasseling (control). Analyzed data showed that significantly highest gross returns, net returns, and benefit: cost ratio was found with the detasseling time after tassel emergence than no detasseling but at par with the 7 days after tassel emergence.

Significantly highest gross returns, net returns, and benefit: cost ratio was recorded with the application of 200 kg N ha^{-1} than the rest of the treatments but at par results with the 150 kg N ha^{-1}.

Conclusion

In view of the above findings, the following conclusion may be drawn:

- Detasseling after tassel emergence proved superior to no detasseling regarding growth, yield attributes and yield, nutrient content and uptake, quality parameters, gross returns, net returns, and B: C ratio of winter baby corn but observed at par with detasseling practice 7 days after tassel emergence.
- Application of 200 kg N ha^{-1} produced higher growth, yield, nutrient content, and their uptake, improved quality parameters, and provided maximum gross returns, net returns, and B: C ratio of winter baby corn but observed at par with the 150 kg N ha^{-1}.

Recommendation

Winter baby corn be grown using 200 kg N ha^{-1} and detasseling after tassel emergence be followed to achieve higher yield and net returns in the eastern Uttar Pradesh.

The study was conducted for one season only therefore the results need further confirmation before making recommendation.

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APPENDICES

Appendix : 1 General cost of cultivation of winter baby corn

S.no.	Operations/Materials	Input	Rate (₹)	Total cost (₹)
1.	Field preparation			
	a. One discing by 35 HP Tractor	1 Tractor 35 HP for 2 hr	400/- hr^{-1}	800.00
	b. Two ploughing and planking	1Tractor 35 HP for 2 hr	400/- hr^{-1}	800.00
2.	Layout	4 man days	320/- $manday^{-1}$	1280.00
3.	Sowing operation	15 man days	320/- $manday^{-1}$	4800.00
4.	seed	40 kg ha^{-1}	400/- kg^{-1}	16000.00
5.	Fertilizer application			
	a. DAP	165.2 kg ha^{-1}	22.5/- kg^{-1}	3717.00
	b. MOP	100 kg ha^{-1}	17/- kg^{-1}	1700.00
6.	Gap filling & Thinning	5 man days	320/- $manday^{-1}$	1600.00
7	Herbicide application			
	a. Herbicide (Topromozon)	75 ml ha^{-1}	1500/- 30 ml^{-1}	3750.00
	b. Labour for spraying	2 man days	320/- $manday^{-1}$	640.00
8.	Earthing up	15 man days	320/- $manday^{-1}$	4800.00
9.	Plant protection			
	a. Emamectine benzoate + Imedachloprid	100 ml ha^{-1}	1000/-100 ml^{-1}	1000.00
	b. Labour for spraying	2 man days	320/- $manday^{-1}$	640.00
10.	Irrigation (5)			
	Labour charge	10 man days	320/- $manday^{-1}$	3200.00
11.	Cob picking	40 man days	320/- $manday^{-1}$	12800.00
12.	Dehusking	25 man days	320/- $manday^{-1}$	8000.00
13.	Fodder harvesting	20 man days	320/- $manday^{-1}$	6400.00
14.	Land revenue	For 4 months	@120 $year^{-1}$	30.00
15.	Interest on working capital	For 4 months	@15% per annum	1798.17
	Total cost			73755.17

Appendix 2: Treatment cost of cultivation (₹ ha^{-1})

Treatment	Nitrogen levels			Detasseling operation		Common cost of cultivation (₹ ha^{-1})	Total cost of cultivation (₹ ha^{-1})
	Urea (kg ha^{-1})	Labour	Nitrogen level cost (₹)	Detasseling labour	Detasseling cost (₹)		
N_1T_1	45.00	2	879.85	0	0	73755.18	74635.03
N_1T_2	45.00	2	879.85	6	1920	73755.18	76555.03
N_1T_3	45.00	2	879.85	6	1920	73755.18	76555.03
N_2T_1	153.42	3	1777.73	0	0	73755.18	75532.90
N_2T_2	153.42	3	1777.73	6	1920	73755.18	77452.90
N_2T_3	153.42	3	1777.73	6	1920	73755.18	77452.90
N_3T_1	262.00	3	2356.46	0	0	73755.18	76111.64
N_3T_2	262.00	3	2356.46	6	1920	73755.18	78031.64
N_3T_3	262.00	3	2356.46	6	1920	73755.18	78031.64
N_4T_1	370.42	3	2934.34	0	0	73755.18	76689.51
N_4T_2	370.42	3	2934.34	6	1920	73755.18	78609.51
N_4T_3	370.42	3	2934.34	6	1920	73755.18	78609.51

Note: Urea: ₹ 266/- 50 kg^{-1}; ₹ 5.33 kg^{-1}; DAP: ₹ 1125/- 50 kg^{-1}; MOP: ₹ 850/- 50kg^{-1}; labour wages: ₹ 320/- day^{-1}.

ANOVA TABLES

Plant height at 30 DAS

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	1.22	0.61				6.58
N	3	2.66	0.89	0.45	3.05	NS	
D	2	8.58	4.30	2.17	3.44	NS	
N×D	6	14.79	2.46	1.24	2.55	NS	
Error	22	43.66	1.98				
Total	35	70.92					

Plant height at 60 DAS

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	4.92	2.46				6.27
N	3	262.92	87.64	6.17	3.05	S	
D	2	58.16	29.08	2.04	3.44	NS	
N×D	6	80.44	13.41	0.94	2.55	NS	
Error	22	312.70	14.21				
Total	35	719.15					

Plant height at 90 DAS

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	117.26	58.63				8.62
N	3	1697.87	565.96	5.83	3.05	S	
D	2	124.33	62.17	0.64	3.44	NS	
N×D	6	460.83	76.81	0.79	2.55	NS	
Error	22	2135.55	97.07				
Total	35	4535.85					

Plant height at harvest

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	107.68	53.84				3.64
N	3	5390.56	1796.85	38.11	3.05	S	
D	2	51.87	25.93	0.55	3.44	NS	
N×D	6	271.43	45.24	0.96	2.55	NS	
Error	22	1037.23	47.15				
Total	35	6858.77					

No. of leaves at 30 DAS

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.06	0.03				3.08
N	3	0.08	0.03	1.10	3.05	NS	
D	2	0.08	0.04	1.59	3.44	NS	
N×D	6	0.13	0.02	0.88	2.55	NS	
Error	22	0.55	0.03				
Total	35	0.91					

No. of leaves at 60 DAS

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.02	0.01				2.84
N	3	1.12	0.37	4.72	3.05	S	
D	2	0.01	0.01	0.08	3.44	NS	
N×D	6	0.55	0.09	1.16	2.55	NS	
Error	22	1.74	0.08				
Total	35	3.46					

No. of leaves at 90 DAS

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	5.11	2.55				4.44
N	3	7.85	2.62	11.22	3.05	S	
D	2	0.55	0.27	1.18	3.44	NS	
N×D	6	2.68	0.45	1.91	2.55	NS	
Error	22	5.13	0.23				
Total	35	21.32					

No. of leaves at harvest

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.67	0.33				5.13
N	3	6.50	2.17	4.21	3.05	S	
D	2	0.79	0.40	0.77	3.44	NS	
N×D	6	2.21	0.37	0.71	2.55	NS	
Error	22	11.33	0.52				
Total	35	21.50					

Dry matter accumulation at 30 DAS

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.005	0.003				14.84
N	3	0.003	0.001	0.496	3.049	NS	
D	2	0.001	0.000	0.131	3.443	NS	
N×D	6	0.011	0.002	0.804	2.549	NS	
Error	22	0.050	0.002				
Total	35	0.070					

Dry matter accumulation at 60 DAS

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.60	0.30				10.84
N	3	2.22	0.74	3.48	3.05	S	
D	2	0.48	0.24	1.14	3.44	NS	
N×D	6	0.94	0.16	0.73	2.55	NS	
Error	22	4.67	0.21				
Total	35	8.91					

Dry matter accumulation at 90 DAS

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	14.42	7.21				23.41
N	3	249.63	83.21	3.39	3.05	S	
D	2	5.82	2.91	0.12	3.44	NS	
N×D	6	74.50	12.42	0.51	2.55	NS	
Error	22	539.51	24.52				
Total	35	883.88					

Dry matter accumulation at harvest

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	182.85	91.43				4.39
N	3	2904.28	968.09	150.05	3.05	S	
D	2	36.82	18.41	2.85	3.44	NS	
N×D	6	66.96	11.16	1.73	2.55	NS	
Error	22	141.94	6.45				
Total	35	3332.85					

Leaf area index at 40 DAS

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.0007	0.0003				9.92
N	3	0.0066	0.0022	5.32	3.05	S	
D	2	0.0004	0.0002	0.43	3.44	NS	
N×D	6	0.0047	0.0008	1.88	2.55	NS	
Error	22	0.0091	0.0004				
Total	35	0.0215					

Leaf area index at 60 DAS

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.01	0.00				9.49
N	3	0.16	0.05	4.36	3.05	S	
D	2	0.03	0.01	1.18	3.44	NS	
N×D	6	0.09	0.01	1.22	2.55	NS	
Error	22	0.27	0.01				
Total	35	0.55					

Leaf area index at 90 DAS

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.35	0.17				13.72
N	3	16.59	5.53	29.66	3.05	S	
D	2	0.29	0.15	0.79	3.44	NS	
N×D	6	0.75	0.12	0.67	2.55	NS	
Error	22	4.10	0.19				
Total	35	22.08					

Chlorophyll content (SPAD values) at 30 DAS

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.13	0.07				3.67
N	3	23.44	7.81	6.01	3.05	S	
D	2	0.29	0.15	0.11	3.44	NS	
N×D	6	6.48	1.08	0.83	2.55	NS	
Error	22	28.59	1.30				
Total	35	58.93					

Chlorophyll content (SPAD values) at 60 DAS

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	3.21	1.61				3.52
N	3	14.57	4.86	3.73	3.05	S	
D	2	4.82	2.41	1.85	3.44	NS	
N×D	6	7.63	1.27	0.98	2.55	NS	
Error	22	28.69	1.30				
Total	35	58.93					

Chlorophyll content (SPAD values) at 90 DAS

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	95.63	47.81				6.31
N	3	971.49	323.83	57.32	3.05	S	
D	2	25.59	12.80	2.26	3.44	NS	
N×D	6	76.59	12.77	2.26	2.55	NS	
Error	22	124.29	5.65				
Total	35	1293.59					

Chlorophyll content (SPAD values) at harvest

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	7.59	3.80				9.19
N	3	1899.37	633.12	49.00	3.05	S	
D	2	28.15	14.07	1.09	3.44	NS	
N×D	6	83.02	13.84	1.07	2.55	NS	
Error	22	284.25	12.92				
Total	35	2302.38					

Initial plant population (ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	8396857.18	4198428.59				0.91
N	3	10340256.52	3446752.17	2.75	3.05	NS	
D	2	596921.80	298460.90	0.24	3.44	NS	
N×D	6	10400567.12	1733427.85	1.38	2.55	NS	
Error	22	27594317.19	1254287.14				
Total	35	57328919.81					

Final plant population (ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	4120839.43	2060419.71				0.90
N	3	10813252.47	3604417.49	3.02	3.05	NS	
D	2	3974561.84	1987280.92	1.67	3.44	NS	
N×D	6	5606302.93	934383.82	0.78	2.55	NS	
Error	22	26229073.85	1192230.63				
Total	35	50744030.51					

Barren plants (ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	12.74					26.10
N	3	498195.34	166065.11	0.92	3.05	NS	
D	2	348736.74	174368.37	0.96	3.44	NS	
N×D	6	1444766.48	240794.41	1.33	2.55	NS	
Error	22	3985562.70	181161.94				
Total	35	6277261.25					

Barrenness (%)

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.001					25.90
N	3	0.373	0.124	1.031	3.049	NS	
D	2	0.222	0.111	0.920	3.443	NS	
N×D	6	0.972	0.162	1.345	2.549	NS	
Error	22	2.650	0.120				
Total	35	4.217					

Days to initiation of baby cob harvest

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	4.39	2.19				0.71
N	3	50.31	16.77	24.69	3.05	S	
D	2	4.39	2.19	3.23	3.44	NS	
N×D	6	0.94	0.16	0.23	2.55	NS	
Error	22	14.94	0.68				
Total	35	74.97					

Days to 50% silk emergence

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	1.35	0.67				0.73
N	3	83.52	27.84	37.15	3.05	S	
D	2	4.68	2.34	3.12	3.44	NS	
N×D	6	1.71	0.28	0.38	2.55	NS	
Error	22	16.49	0.75				
Total	35	107.74					

Period of harvest (days)

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	2.06	1.03				3.20
N	3	202.31	67.44	224.41	3.05	S	
D	2	3.39	1.69	5.64	3.44	S	
N×D	6	1.94	0.32	1.08	2.55	NS	
Error	22	6.61	0.30				
Total	35	216.31					

Number of baby cobs plant^{-1}

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.00	0.00				3.62
N	3	4.69	1.56	93.05	3.05	S	
D	2	0.19	0.09	5.57	3.44	S	
N×D	6	0.17	0.03	1.67	2.55	NS	
Error	22	0.37	0.02				
Total	35	5.42					

Baby corn length (cm)

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.34	0.17				9.43
N	3	11.17	3.72	4.35	3.05	S	
D	2	7.68	3.84	4.49	3.44	S	
N×D	6	0.87	0.15	0.17	2.55	NS	
Error	22	18.83	0.86				
Total	35	38.88					

Baby corn girth (cm)

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.001	0.001				2.58
N	3	0.14	0.05	41.51	3.05	S	
D	2	0.02	0.01	10.70	3.44	S	
N×D	6	0.00	0.001	0.45	2.55	NS	
Error	22	0.03	0.001				
Total	35	0.20					

Baby cob weight (g)

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	17.66	8.83				4.00
N	3	222.67	74.22	32.01	3.05	S	
D	2	39.90	19.95	8.60	3.44	S	
N×D	6	2.67	0.45	0.19	2.55	NS	
Error	22	51.02	2.32				
Total	35	333.93					

Baby corn weight (g)

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.40	0.20				4.77
N	3	13.56	4.52	28.17	3.05	S	
D	2	5.15	2.57	16.04	3.44	S	
N×D	6	0.36	0.06	0.38	2.55	NS	
Error	22	3.53	0.16				
Total	35	22.99					

Baby cob: baby corn ratio

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.55	0.28				5.79
N	3	0.04	0.01	0.18	3.05	NS	
D	2	0.21	0.10	1.50	3.44	NS	
N×D	6	0.14	0.02	0.35	2.55	NS	
Error	22	1.53	0.07				
Total	35	2.47					

Baby cob yield (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	56490.17	28245.08				4.57
N	3	74066336.56	24688778.85	162.74	3.05	S	
D	2	6349387.17	3174693.58	20.93	3.44	S	
N×D	6	136757.28	22792.88	0.15	2.55	NS	
Error	22	3337543.83	151706.54				
Total	35	83946515.00					

Baby corn yield (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	91172.69	45586.34				7.61
N	3	3935178.47	1311726.16	63.87	3.05	S	
D	2	579816.54	289908.27	14.12	3.44	S	
N×D	6	31343.88	5223.98	0.25	2.55	NS	
Error	22	451798.61	20536.30				
Total	35	5089310.18					

Fodder yield (t ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	16.22	8.11				10.63
N	3	527.24	175.75	28.32	3.05	S	
D	2	3.13	1.56	0.25	3.44	NS	
N×D	6	43.42	7.24	1.17	2.55	NS	
Error	22	136.51	6.21				
Total	35	726.52					

Baby cob Ist picking (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	179083.56	89541.78				6.69
N	3	9702001.00	3234000.33	135.92	3.05	S	
D	2	699761.06	349880.53	14.70	3.44	S	
N×D	6	31913.17	5318.86	0.22	2.55	NS	
Error	22	523463.78	23793.81				
Total	35	11136222.56					

Baby cob IInd picking (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	144406.06	72203.03				6.80
N	3	8172824.22	2724274.74	45.45	3.05	S	
D	2	791868.39	395934.19	6.61	3.44	S	
N×D	6	54289.61	9048.27	0.15	2.55	NS	
Error	22	1318677.28	59939.88				
Total	35	10482065.56					

Baby cob IIIrd picking (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	114383.39	57191.69				10.73
N	3	4041323.86	1347107.95	33.34	3.05	S	
D	2	285171.72	142585.86	3.53	3.44	S	
N×D	6	18696.06	3116.01	0.08	2.55	NS	
Error	22	889043.28	40411.06				
Total	35	5348618.31					

Baby cob IVth picking (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	7778.39	3889.19				14.63
N	3	430605.86	143535.29	62.31	3.05	S	
D	2	68270.22	34135.11	14.82	3.44	S	
N×D	6	2260.89	376.81	0.16	2.55	NS	
Error	22	50676.94	2303.50				
Total	35	559592.31					

Baby corn I^st^ picking (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	13084.30	6542.15				8.28
N	3	510010.48	170003.49	68.62	3.05	S	
D	2	61467.27	30733.64	12.41	3.44	S	
N×D	6	3075.01	512.50	0.21	2.55	NS	
Error	22	54500.94	2477.32				
Total	35	642138.00					

Baby corn II^nd^ picking (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	43401.57	21700.78				10.36
N	3	445466.71	148488.90	21.78	3.05	S	
D	2	81918.84	40959.42	6.01	3.44	S	
N×D	6	6495.37	1082.56	0.16	2.55	NS	
Error	22	150002.79	6818.31				
Total	35	727285.28					

Baby corn IIIrd picking (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	381.40	190.70				10.78
N	3	212935.87	70978.62	35.78	3.05	S	
D	2	26063.90	13031.95	6.57	3.44	S	
N×D	6	2969.75	494.96	0.25	2.55	NS	
Error	22	43645.71	1983.90				
Total	35	285996.62					

Baby corn IVth picking (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	768.85	384.43				12.82
N	3	21782.32	7260.77	83.76	3.05	S	
D	2	4376.12	2188.06	25.24	3.44	S	
N×D	6	247.00	41.17	0.47	2.55	NS	
Error	22	1907.10	86.69				
Total	35	29081.39					

Baby corn N content (%)

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.10	0.05				10.10
N	3	1.18	0.39	8.83	3.05	S	
D	2	0.75	0.38	8.43	3.44	S	
N×D	6	0.28	0.05	1.05	2.55	NS	
Error	22	0.98	0.04				
Total	35	3.29					

Cob husk N content (%)

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.001	0.001				11.591
N	3	0.635	0.212	11.297	3.049	S	
D	2	0.246	0.123	6.565	3.443	S	
N×D	6	0.171	0.029	1.524	2.549	NS	
Error	22	0.412	0.019				
Total	35	1.465					

Fodder N content (%)

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.006	0.003				9.015
N	3	0.942	0.314	31.215	3.049	**S**	
D	2	0.082	0.041	4.068	3.443	**S**	
N×D	6	0.018	0.003	0.294	2.549	**NS**	
Error	22	0.221	0.010				
Total	35	1.270					

Baby corn P content (%)

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.003	0.001				7.324
N	3	0.034	0.011	13.032	3.049	S	
D	2	0.021	0.011	12.110	3.443	S	
N×D	6	0.004	0.001	0.715	2.549	NS	
Error	22	0.019	0.001				
Total	35	0.080					

Cob husk P content (%)

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.0015	0.0008				9.9987
N	3	0.0412	0.0137	23.1987	3.0491	S	
D	2	0.0053	0.0026	4.4790	3.4434	S	
N×D	6	0.0004	0.0001	0.1117	2.5491	NS	
Error	22	0.0130	0.0006				
Total	35	0.0614					

Fodder P content (%)

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.0020	0.0010				21.2749
N	3	0.0484	0.0161	23.7922	3.0491	S	
D	2	0.0053	0.0026	3.8693	3.4434	S	
N×D	6	0.0017	0.0003	0.4209	2.5491	NS	
Error	22	0.0149	0.0007				
Total	35	0.0724					

Baby corn K content (%)

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.0049	0.0025				3.3729
N	3	0.1272	0.0424	20.1599	3.0491	S	
D	2	0.0160	0.0080	3.8091	3.4434	S	
N×D	6	0.0022	0.0004	0.1781	2.5491	NS	
Error	22	0.0463	0.0021				
Total	35	0.1967					

Cob husk K content (%)

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.02	0.01				22.63
N	3	1.58	0.53	17.89	3.05	S	
D	2	0.24	0.12	4.06	3.44	S	
N×D	6	0.02	0.00	0.10	2.55	NS	
Error	22	0.65	0.03				
Total	35	2.50					

Fodder K content (%)

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.018	0.009				3.287
N	3	0.595	0.198	60.792	3.049	S	
D	2	0.073	0.037	11.250	3.443	S	
N×D	6	0.033	0.006	1.704	2.549	NS	
Error	22	0.072	0.003				
Total	35	0.791					

Baby corn N uptake (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.05	0.02				13.66
N	3	22.55	7.52	25.07	3.05	S	
D	2	10.74	5.37	17.91	3.44	S	
N×D	6	1.37	0.23	0.76	2.55	NS	
Error	22	6.60	0.30				
Total	35	41.30					

Cob husk N uptake (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	8.93	4.46				12.11
N	3	5185.59	1728.53	56.81	3.05	S	
D	2	841.64	420.82	13.83	3.44	S	
N×D	6	198.02	33.00	1.08	2.55	NS	
Error	22	669.43	30.43				
Total	35	6903.61					

Fodder N uptake (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	271.64	135.82				10.04
N	3	19356.86	6452.29	99.47	3.05	S	
D	2	1198.23	599.11	9.24	3.44	S	
N×D	6	101.32	16.89	0.26	2.55	NS	
Error	22	1427.12	64.87				
Total	35	22355.15					

Total N uptake (kg ha-^{1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	184.05	92.02				7.42
N	3	46394.23	15464.74	166.85	3.05	S	
D	2	4475.51	2237.75	24.14	3.44	S	
N×D	6	254.93	42.49	0.46	2.55	NS	
Error	22	2039.07	92.68				
Total	35	53347.78					

Baby corn P uptake (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.001	0.001				12.628
N	3	0.797	0.266	28.056	3.049	S	
D	2	0.354	0.177	18.709	3.443	S	
N×D	6	0.070	0.012	1.238	2.549	NS	
Error	22	0.208	0.009				
Total	35	1.431					

Cob husk P uptake (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	4.56	2.28				11.01
N	3	268.92	89.64	83.13	3.05	S	
D	2	25.93	12.96	12.02	3.44	S	
N×D	6	2.07	0.35	0.32	2.55	NS	
Error	22	23.72	1.08				
Total	35	325.21					

Fodder P uptake (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	2.56	1.28				22.43
N	3	494.19	164.73	40.24	3.05	S	
D	2	41.89	20.94	5.12	3.44	S	
N×D	6	7.87	1.31	0.32	2.55	NS	
Error	22	90.06	4.09				
Total	35	636.57					

Total P uptake (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	12.20	6.10				13.00
N	3	1541.95	513.98	82.30	3.05	S	
D	2	143.71	71.86	11.51	3.44	S	
N×D	6	13.06	2.18	0.35	2.55	NS	
Error	22	137.39	6.25				
Total	35	1848.33					

Baby corn K uptake (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.22	0.11				9.05
N	3	6.14	2.05	37.29	3.05	S	
D	2	1.67	0.84	15.23	3.44	S	
N×D	6	0.32	0.05	0.97	2.55	NS	
Error	22	1.21	0.05				
Total	35	9.57					

Cob husk K uptake (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	24.24	12.12				22.79
N	3	1462.76	487.59	26.60	3.05	S	
D	2	360.80	180.40	9.84	3.44	S	
N×D	6	10.71	1.78	0.10	2.55	NS	
Error	22	403.20	18.33				
Total	35	2261.71					

Fodder K uptake (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	1603.39	801.69				5.77
N	3	28108.22	9369.41	183.37	3.05	S	
D	2	1648.29	824.14	16.13	3.44	S	
N×D	6	205.33	34.22	0.67	2.55	NS	
Error	22	1124.10	51.10				
Total	35	32689.32					

Total K uptake (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	1328.10	664.05				5.70
N	3	43378.98	14459.66	211.03	3.05	S	
D	2	3701.14	1850.57	27.01	3.44	S	
N×D	6	238.22	39.70	0.58	2.55	NS	
Error	22	1507.44	68.52				
Total	35	50153.88					

Baby corn protein content (%)

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	3.92	1.96				10.10
N	3	46.04	15.35	8.83	3.05	S	
D	2	29.32	14.66	8.43	3.44	S	
N×D	6	10.95	1.82	1.05	2.55	NS	
Error	22	38.24	1.74				
Total	35	128.46					

Cob husk protein content (%)

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.05	0.02				11.59
N	3	24.79	8.26	11.30	3.05	S	
D	2	9.60	4.80	6.56	3.44	S	
N×D	6	6.69	1.11	1.52	2.55	NS	
Error	22	16.09	0.73				
Total	35	57.22					

Fodder protein content (%)

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.25	0.13				9.02
N	3	36.81	12.27	31.21	3.05	S	
D	2	3.20	1.60	4.07	3.44	S	
N×D	6	0.69	0.12	0.29	2.55	NS	
Error	22	8.65	0.39				
Total	35	49.59					

Baby corn protein harvest (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	1.80	0.90				13.66
N	3	880.93	293.64	25.07	3.05	S	
D	2	419.48	209.74	17.91	3.44	S	
N×D	6	53.47	8.91	0.76	2.55	NS	
Error	22	257.67	11.71				
Total	35	1613.35					

Cob husk protein harvest (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	171.69	85.85				11.80
N	3	21862.13	7287.38	17.08	3.05	S	
D	2	20680.97	10340.49	24.24	3.44	S	
N×D	6	3946.80	657.80	1.54	2.55	NS	
Error	22	9384.15	426.55				
Total	35	56045.75					

Fodder protein harvest (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	10610.79	5305.40				10.04
N	3	756127.17	252042.39	99.47	3.05	S	
D	2	46805.71	23402.85	9.24	3.44	S	
N×D	6	3957.70	659.62	0.26	2.55	NS	
Error	22	55746.84	2533.95				
Total	35	873248.21					

Total protein harvest (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	8174.54	4087.27				7.37
N	3	1070794.95	356931.65	133.65	3.05	S	
D	2	144851.39	72425.69	27.12	3.44	S	
N×D	6	6377.22	1062.87	0.40	2.55	NS	
Error	22	58755.76	2670.72				
Total	35	1288953.85					

Total carbohydrates content (%)

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	39.01	19.50				2.90
N	3	578.61	192.87	48.17	3.05	S	
D	2	29.70	14.85	3.71	3.44	S	
N×D	6	3.76	0.63	0.16	2.55	NS	
Error	22	88.09	4.00				
Total	35	739.17					

Starch content (%)

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	53.79	26.89				10.52
N	3	529.08	176.36	4.25	3.05	S	
D	2	425.91	212.95	5.14	3.44	S	
N×D	6	529.82	88.30	2.13	2.55	NS	
Error	22	912.22	41.46				
Total	35	2450.81					

Total soluble sugar (%)

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.06	0.03				9.35
N	3	0.66	0.22	10.64	3.05	S	
D	2	0.14	0.07	3.50	3.44	S	
N×D	6	0.03	0.00	0.22	2.55	NS	
Error	22	0.45	0.02				
Total	35	1.35					

Available soil nitrogen (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	45.91	22.96				9.17
N	3	7388.73	2462.91	8.29	3.05	S	
D	2	4100.60	2050.30	6.90	3.44	S	
N×D	6	3374.40	562.40	1.89	2.55	NS	
Error	22	6533.56	296.98				
Total	35	21443.20					

Available soil phosphorous (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.22	0.11				2.58
N	3	1.21	0.40	2.95	3.05	NS	
D	2	0.24	0.12	0.86	3.44	NS	
N×D	6	0.15	0.03	0.19	2.55	NS	
Error	22	3.01	0.14				
Total	35	4.83					

Available soil potassium (kg ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	188.47	94.23				3.39
N	3	155.34	51.78	1.30	3.05	NS	
D	2	57.61	28.80	0.72	3.44	NS	
N×D	6	502.59	83.77	2.11	2.55	NS	
Error	22	874.11	39.73				
Total	35	1778.12					

Gross returns (₹ ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	272847809.04	136423904.52				6.56
N	3	49647447815.02	16549149271.67	78.84	3.05	S	
D	2	2538724916.18	1269362458.09	6.05	3.44	S	
N×D	6	1392823164.60	232137194.10	1.11	2.55	NS	
Error	22	4618075546.98	209912524.86				
Total	35	58469919251.82					

Net returns (₹ ha^{-1})

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	272847809.04	136423904.52				10.08
N	3	47674861344.78	15891620448.26	75.71	3.05	S	
D	2	2136925068.35	1068462534.18	5.09	3.44	S	
N×D	6	1392823164.60	232137194.10	1.11	2.55	NS	
Error	22	4618075546.98	209912524.86				
Total	35	56095532933.75					

Benefit: cost ratio

Source of variation	d. f.	S.S.	M.S.S.	Cal. F value	Tab. F value at 5%	Result	CV
Replication	2	0.04	0.02				10.08
N	3	7.47	2.49	70.71	3.05	S	
D	2	0.26	0.13	3.65	3.44	S	
N×D	6	0.23	0.04	1.09	2.55	NS	
Error	22	0.77	0.04				
Total	35	8.77					