POTENTIAL PERFORMANCE OF GROUNDNUT (*Arachis hypogaea* L.) CULTIVARS TO LEVELS OF NITROGEN

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B.Sc. (Ag.)

MASTER OF SCIENCE IN AGRICULTURE

(AGRONOMY)

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B.Sc., (Ag.)

THESIS SUBMITTED TO THE
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CHAIRPERSON: Dr. P.V.N PRASAD

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DEPARTMENT OF AGRONOMY

AGRICULTURAL COLLEGE, BAPATLA
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DECLARATION

I, Mr. SHAIK VASEEM AKRAM, hereby declare that the thesis entitled "**POTENTIAL PERFORMANCE OF GROUNDNUT (*Arachis hypogaea* L.) CULTIVARS TO LEVELS OF NITROGEN"** submitted to the **Acharya N. G. Ranga Agricultural University** for the degree of **Master of Science in Agriculture** in the major field of **Agronomy** is the result of original research work done by me. I also declare that no material contained in the thesis has been published earlier in any manner.

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Date:

CERTIFICATE

Mr. SHAIK VASEEM AKRAM has satisfactorily prosecuted the course of research and that thesisentitled "**POTENTIAL PERFORMANCE OF GROUNDNUT (*Arachis hypogaea* L.) CULTIVARS TO LEVELS OF NITROGEN**" submitted is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that neither the thesis nor its part thereof has been previously submitted by him for a degree of any University.

Date: **(P.V.N PRASAD)**

Place: Chairperson

CERTIFICATE

This is to certify that the thesis entitled "**POTENTIAL PERFORMANCE OF GROUNDNUT (*Arachis hypogaea* L.) CULTIVARS TO LEVELS OF NITROGEN**" submitted in partial fulfilment of the requirements for the degree of **'MASTER OF SCIENCE IN AGRICULTURE'** of the Acharya N. G. Ranga Agricultural University, Lam, Guntur is a record of the bonafide original research work carried out by **Mr. SHAIK VASEEM AKRAM** under our guidance and supervision.

No part of the thesis has been submitted by the student for any other degree or diploma. The published part and all the assistance received during the course of the investigations have been duly acknowledged by the author of the thesis.

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Place : Bapatla

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LIST OF SYMBOLS AND ABBREVIATIONS

@	:	At the rate of
%	:	Per cent
^0C	:	Degree Celsius
CD (P=0.05)	:	Critical Difference at 5 per cent probability level
cm	:	Centimetre
CV	:	Coefficient of variance
DAS	:	Days after sowing
dSm^{-1}	:	Decisiemen per metre
EC	:	Electrical conductivity
et al.	:	and others
fig	:	Figure
g	:	Gram
ha^{-1}	:	Per hectare
$plant^{-1}$	:	Per plant
pod^{-1}	:	Per pod
HI	:	Harvest index
K	:	Potassium
P	:	Phosphorus
kg	:	Kilogram
kg ha^{-1}	:	Kilogram per hectare
m^{-2}	:	Per square metre
M.ha	:	Million hactares
M.t	:	Million tonnes
N	:	Nitrogen
NS	:	Non-significant
pH	:	Potential of hydrogen ion concentration

RH	:	Relative humidity
Rs ha^{-1}	:	Rupees per hectare
AHRS	:	Agricultural and Horticultural Research Station
UAHS	:	University of Agricultural and Horticultural Sciences
GKVK	:	Gandhi Krishi Vigyana Kendra
RDF	:	Recommended dose of fertilizer
Sem	:	Standard error of mean
viz.	:	Namely

ABSTRACT

Author	:	**SHAIK VASEEM AKRAM**
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A field experiment entitled "**Potential performance of groundnut (*Arachis hypogaea* L.) cultivars to levels of nitrogen''** was conducted during *rabi* 2020 on sandy loam soils of Agricultural College Farm, Bapatla, Acharya N.G. Ranga Agricultural University, Andhra Pradesh. The experiment was laid out in a Randomized Block Design with factorial concept and replicated thrice. The treatments consisted of three varieties V_1: Dharani, V_2: Kadiri lepakshi and V_3: TAG-24 and four nitrogen levels *viz*., N_1: 0 kg N ha^{-1} N_2: 25 kg N ha^{-1} N_3: 50 kg N ha^{-1} and N_4: 75 kg N ha^{-1}.

The results indicated that among the three varieties tested, the plant height of dharani (V_1) was significantly taller and found superior over kadiri lepakshi (V_2) and TAG -24(V_3). The number of branches $plant^{-1}$recorded with kadiri lepakshi (V_2) was significantly higher over other two varieties. The drymatter accumulation observed with kadiri lepakshi (V_2) was significantly the maximum over TAG 24 and was found on par with dharani (V_1). Similarly number of pods $plant^{-1}$and number of filled pods $plant^{-1}$were significantly more with kadiril epakshi (V_2), than that of dharani (V_1) and TAG -24 (V_3). Pod yield, haulm yield and kernel yield were recorded significantly higher with kadiri lepakshi (V_2) followed by dharani (V_1) over TAG-24.

Among the four levels of nitrogen tried the growth characters *viz*., plant height, number of branches plant^{-1}, drymatter accumulation and nodule dry weight were higher with the application of 75 kg N ha^{-1} followed by 50 kg N ha^{-1}, which were however statistically on par with each other and was found significantly superior to other levels of nitrogen. Similarly, number of pods plant^{-1}, number of filled pods plant^{-1}, pod yield and haulm yield were also registered higher with 75 kg N ha^{-1} and found significantly superior to that of 25 kg N ha^{-1} and control respectively.

Nitrogen content (%) did not exhibit significant differences with varieties at 30,60 DAS and at harvest. Nitrogen uptake (kg ha^{-1}) was recorded the highest with kadiri lepakshi (V_2) followed by dharani (V_1), whereas nitrogen content and uptake increased significantly with incremental increase in nitrogen level and higher uptake of N was attained with 75 kg N ha^{-1}, which was on par with 50 kg N ha^{-1}. Protein content recorded was the highest with 75 kg N ha^{-1} followed by 50 kg N ha^{-1}.

The maximum oil content (%) and oil yield (kg ha^{-1}) were obtained with variety kadiri lepakshi (V_2) followed by dharani (V_1) and the lowest was observed with TAG-24. There was no significant difference observed in respect of oil content and oil yield with increasing levels of nitrogen.

The higher gross returns was achieved with kadiri lepakshi (V_2) was found on par with dharani (V_1). While application of 75 kg N ha^{-1} recorded the maximum gross returns and it was found on par with 25 kg and 50 kg N ha^{-1}.Net returns and B:C ratio followed the similar trend as that of gross returns with respect to nitrogen levels.

With increase in levels of nitrogen application, the soil available N also increased. Application of nitrogen @ 75 kg N ha^{-1} resulted in significantly higher available soil N, which was however, on par with the treatment that received 50 kg N ha^{-1}.

Interaction between varieties and nitrogen levels was found to be non-significant for all parameters studied.

It can be concluded from the present investigation that higher growth parameters, yield parameters, gross returns were recorded with kadiri lepakshi (V_2) with the application of 50 kg N ha^{-1} which can be advisable under rainfed conditions of coastal Andhra Pradesh.

Chapter I

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) being one of the most important cash crops of the world and referred to as poor man's almond as well as "King of oilseeds" is also a major oilseed crop of India. To meet the vegetable oil requirement of India at optimum level, it is very essential in the present scenario to increase the production from the present level of 36.5M.t to about 84.5M.t by 2050 AD (Ministry of Agriculture and Farmers Wellfare, Govt of India. *www.ap.gov.in*. 2020-2021.) to achieve near self – reliance in vegetable oil production. However, with the growth of other conventional and non – conventional vegetable oilseed crops in the recent past, pressure on cultivation of this crop as a source of edible oil has eased considerably and now it could be looked upon as an eminent producer of highly nutritive food besides oil. Peanut, with its invogorating characteristics, bestowed with 45-50 % kernel oil, 25 % protein, 25 % carbohydrates and 5 % fibre as well as ash is considered as a cheap source of stable and nutritive food for the under nourished and poverty stricken population to overcome protein malnutrition.

India is the second largest producer of groundnut after China since it accounts for 34.5% of the world's groundnut area with 27.3 % production and a total area of 4.9 M. ha producing 9.25 M.t. India has an average productivity of 1893 kg ha^{-1}. Among the different states of India Gujarat with 41.35% of total production is the lead producer followed by Rajasthan (13.76%), Andhra Pradesh (12.28%) Tamil Nadu (10.55 %) and Karnataka (5.14%). Andhra Pradesh occupies an area of 0.73 M. ha producing 1.04 M.t with a productivity of 1426 kg ha^{-1} (www.indiastat.com 2017- 2018).

Groundnut productivity in India is very low compared to other nations and its production needs to be enhanced to fulfill the national shortfall since its availability as edible oil is only 12 kg/head/year against the nutritional requirement of 14.8 kg/head/year (Ministry of Agriculture and Farmers

Wellfare, Govt of India. *www.ap.gov.in*. 2020-2021.). Among the several reasons attributed for reduced yield, nitrogen deficiency is considered as one of the major constraints. Growth and development of any crop for that matter is closely associated with the augmentation of root system and nitrogen being the precursor element stimulate both root and shoot fabrication. Therefore, selecting the optimum dose of nitrogen containing fertilizer becomes even more necessary for having the highest propagation level, because adsorption of adequate quantity of this element by the leaves consequently leads to increased protein content besides larger legume seeds. Further when applied in ammonical form to the soil it induces acidification in the rhizosphere with reduced pH resulting in higher root proliferation (Chakraborthy, 2019).

Despite phenomenal increase in the production and productivity of groundnut over the last decade there are regional disparities in the productivity within the country. A multitude factors such as confining the crop to semi- arid regions under marginal and sub- marginal lands, erratic rainfall distribution, use of non- descriptive cultivars, poor management of crop with inadequate or imbalanced use of inputs etc are a few to name, responsible for depressed yields under rainfed condition. As productivity of groundnut largely depends upon selection of suitable genotype it is recognised that optimal combination of genotype with the requisite nutrient quantity assumes pragmatic reassessment to manifest the potential performance of the cultivar (Uddin *et al*., 2016). Among the diversified groundnut genotypes the bunchy erect type that demonstrated a favourable response to higher doses of nitrogen has drawn the attention of Andhra Pradesh farmers.

Oilseeds being energy rich crops demand increased quantity of nutrients for the manifestation of their production potentiality. With the evolution of new generation groundnut varieties of varied maturity exhibiting response to additionally added nitrogen, its judicious management besides determining the favourable requirement has become fairly necessary. Hence for optimisation of mineral nutrition the key component to stabilize groundnut production, recommendation of a nutrient response cultivar with adequate fertilizer application to help and standardize the nutrient requirement for ostentation of yield feasibility has been a long felt need in the sandy loam soils of the region. In the light of above justification, the present study on potential performance of groundnut cultivars to levels of nitrogen was conducted with the following objectives.

Objectives of Investigation:

1. To study the effect and the performance of groundnut varieties to various levels of nitrogen.
2. To arrive at the optimum rate of nitrogen schedule for groundnut genotypes in the *rabi* season.
3. To work out the economics.

Chapter II

REVIEW OF LITERATURE

The literature pertaining to the present investigation on "**Potential performance of groundnut (*Arachis hypogaea* L.) cultivars to levels of nitrogen**'' has been reviewed in this chapter. Perusal of literature reveals the effect of different nitrogen levels to groundnut varieties and the experiment is studied with following sub- heads:

2.1. Effect of varieties on growth parameters of groundnut

2.2. Effect of varieties on yield attributes of groundnut

2.3. Effect of varieties on yield of groundnut

2.4. Effect of levels of nitrogen on growth parameters of groundnut

2.5. Effect of levels of nitrogen on yield attributes of groundnut

2.6. Effect of levels of nitrogen on yield of groundnut

2.7. Effect of varieties and nitrogen levels on quality parameters of groundnut

2.8. Effect of levels of nitrogen on soil properties and nitrogen uptake of groundnut

2.9. Effect of varieties and levels of nitrogen on economics of groundnut.

2.1 EFFECT OF VARIETIES ON GROWTH PARAMETERS OF GROUNDNUT

2.1.1 Plant Height (cm)

Groundnut plants of TMV-2 variety were significantly taller compared to JL-24 and Tirupati-2 in an experiment conducted on sandy loam soils of Tirupati, Andhra Pradesh, under rainfed conditions (Bharatha Lakshmi and Sambasiva Reddy, 2001).

Samui *et al.* (2004) noticed the highest plant height with groundnut variety JL-24 and was comparable with SB-11 during *kharif* and summer seasons at Gayashpur, West Bengal.

Soumya *et al.* (2011) reported that the highest plant height was measured with the variety narayani compared to ICGV-91114, kadiri-6 and JCG- with significant disparity between any two of themon sandy loam soil of Hyderabad, during *kharif*.

Krishna Reddy *et al.* (2013) reported that the groundnut variety dharani recorded significantly higher plant height compared to greeshma in sandy loam soils of Tirupati, Andhra Pradesh, during early *kharif*.

The results of the experiment conducted by Patil *et al.* (2014) revealed that variety SB-XI recorded the highest plant height, compared to TAG-24, Konkan Tromba Tapora and Konkan Gaurav.

Reddy *et al.* (2014) reported from a field experiment conducted at University of Agricultural Sciences, Bengularu that kaushal variety recorded the maximum plant height than chitra variety.

A field experiment conducted by Jangilwad *et al.* (2015) at Sardarkrushinagar on sandy loam soils of Gujarat revealed that highest plant height recorded with GG-5 variety at 90 DAS (27.61 cm) and at harvest (41.05 cm) was on par with GG-7 variety with (27.50 cm) and (41.00 cm) respectively.

An experiment was conducted at College of Agriculture, Kolhapur, Maharashtra on sandy clay loam soils by Mate *et al.* (2017) who stated that groundnut variety JL-501 recorded the maximum plant height (22.93 cm) than that of the variety JL24 (22.07 cm)

Shendage *et al.* (2018) conducted a field experiment at Kolhapur to study the "effect of sowing times and varieties on growth and yield of summer groundnut (*Arachis hypogaea* L.)" and reported that plant height was highest in variety JL- 501 followed by TAG-24.

2.1.2 Number of Branches Plant^{-1}

Mouri *et al.* (2018) conducted a field experiment at Bangladesh Agricultural University and revealed that variety BARI Cheenabadam-8 produced more number of branches plant^{-1} over variety BINA Cheenabadam-6.

Among the four groundnut varieties studied GKVK-5, GPBD-4, G2-52 and TMV-2, it was observed that the variety GKVK-5 recorded maximum number of branches plant^{-1} (10.41) than other varieties GPBD-4 (9.75), G2-52 (10.06) and TMV-2 (8.85) (Raagavalli *et al*., 2019).

An experiment conducted during the *kharif* cropping season revealed that the variety ICG-163 recorded significantly higher mean number of branches plant^{-1}(7.77) than other varieties tried in the experiment. (Vijayakumar *et al*., 2019).

2.1.3 Drymatter Accumulation (kg ha^{-1})

Bharatha Lakshmi and Sambasiva Reddy (2001) reported that groundnut variety, JL-24 resulted in significantly higher drymatter production compared to TMV-2 and TPT-2 on sandy loam soils of Tirupati, Andhra Pradesh, under rainfed conditions.

Talwar *et al.* (2002) conducted a field trial at the research farm of the Regional Research Station, Central Arid Zone Research Institute (CAZRI), Bikaner in Rajasthan and reported that among the ten varieties ICGV-92113 produced the maximum drymatter accumulation.

Among the different varieties evaluated, the variety ASK 2002-7 recorded the highest drymatter production followed by ASK 2003-3, ASK 2002-11 and ALR-2 with significant disparity between any two of them on sandy loam soils of Aliyarnagar, Tamil Nadu, during *rabi* (Chandrasekaran *et al*., 2007).

The groundnut variety, kadiri-6 recorded significantly higher drymatter accumulation than JCG-88 and ICGV-91114, however, it was on par with narayani at 60 days after sowing on sandy loam soils of Rajendranagar, Hyderabad, during *kharif* (Soumya *et al*., 2011).

The results of the experiment conducted by Patil *et al.* (2014) revealed that variety SB-XI recorded significantly the highest drymatter accumulation plant^{-1} and it was found on par with TAG-24.

2.1.4 Days to 50 per cent Flowering and Days to Maturity

The maximum number of days to 50 per cent flowering and days to maturity were recorded with K-134 while the minimum number of days to 50 per cent flowering and maturity were registered with TAG-24 on sandy loam soils of Rajendranagar, Hyderabad, during *rabi* (Ramesh, 2002).

Soumya *et al*. (2011) stated that number of days to 50 per cent flowering and days to maturity were the maximum with JCG-88 variety, while the minimum number of days to 50 per cent flowering was observed with ICGV-91114, among the varieties tried on sandy loam soil of Rajendranagar, Hyderabad, during *kharif*.

2.2 EFFECT OF VARIETIES ON YIELD ATTRIBUTESOF GROUNDNUT

2.2.1 Number of Pods Plant^{-1}

Total number of pods plant^{-1} were significantly higher with TAG-24 compared to LGN-2 on medium deep clay soils of Parbani, Maharashtra, during *rabi* (Jadhav *et al*., 2000).

Bharatha Lakshmi and Sambasiva Reddy (2001) observed that the total number of pods plant^{-1} were higher with the variety TMV-2 followed by Tirupati-2 and JL-24, with significant disparity among them on sandy loam soils of Tirupati, Andhra Pradesh, under rainfed conditions.

Brar *et al*. (2004) in an experiment conducted on sandy loamy soils of Ludhiana, Punjab, under irrigated conditions stated that the total number of pods plant^{-1} were significantly higher in SG-84 as compared to M-522 groundnut variety.

Bharud and Pawar (2005) observed that the total number of pods plant^{-1} were significantly higher with the variety ICGS-11 followed by RHRG-95, TG-26, TAG-24, JL-286, RHRG-100 and SB-XI during summer at Rahuri.

Among the different varieties evaluated, the variety ASK 2002-7 recorded the highest number of pods plant^{-1} followed by ASK 2003- 3, ASK 2002-11 and ALR-2, with significant disparity between any two of them during *rabi* on sandy loam soils of Aliyarnagar, Tamil Nadu (Chandrasekaran *et al*., 2007).

Ramesh and Sambasiva Reddy (2007) reported that K-134 recorded significantly higher number of pods plant^{-1} than TMV-2, TPT-2 and TAG-24 during*rabi* season under irrigated conditions.

Total number of pods plant^{-1} differed significantly among the varieties and the highest number of pods plant^{-1} was recorded with narayani followed by K-6, JCG-88 and ICGV-91114, on sandy loam soils of Rajendranagar, Hyderabad, during *kharif* (Soumya *et al*., 2011).

Shendage *et al*. (2018) conducted a field experiment at College of Agriculture, Kolhapur and reported that significantly higher number of pods plant^{-1} was recorded with variety JL-501 compared to TAG-24.

A field experiment conducted by Mouri *et al.* (2018) at Bangladesh Agricultural University revealed that BARI Cheenabadam-8 produced significantly the highest number of pods plant^{-1} (44.50) than BINA Cheenabadam-6.

2.2.2 Number of Filled Pods Plant^{-1}

Nigam *et al*. (2005) reported that the highest number of filled pods plant^{-1} was recorded with ICGV-91114 as compared to TMV-2.

Kareem (2006) reported that ICGV-91114 performed better in producing more number of filled pods plant^{-1} as compared to K-134 and TMV-2.

Groundnut cultivar B 95 produced the highest number of filled pods plant^{-1} which was comparable with that of the cultivar GG 5 (Subrahmaniyam and Kalaiselvam, 2006).

Ramesh and Sambasiva Reddy (2007) reported that K-134 recorded significantly higher number of filled pods plant^{-1} than TMV-2, TPT-2 and TAG-24 during *rabi* season under irrigated conditions.

In an experiment conducted in Bangladesh on loamy soils during *rabi*, Howlander *et al*. (2009) reported that the number of filled pods plant^{-1} were the highest with Dhaka-1 as compared to DG-2.

2.2.3 100 Kernel Weight (g)

The hundred kernel weight obtained with JL-24 was significantly higher as compared to TMV-2 and Tirupati-2 at Tirupati, Andhra Pradesh, on sandy loam soils under rainfed conditions (Bharatha Lakshmi and Sambasiva Reddy, 2001).

Bharud and Pawar (2005) observed that the hundred kernel weight was significantly higher with the variety TAG-24 than TG-26 that were examined during summer at Rahuri, Maharashtra.

A field experiment conducted by Kathirvelan and Kalaiselvan (2006) during *rabi* at Tamil Nadu Agricultural University, Coimbatore on sandy loamy soils revealed that TG 41 groundnut variety recorded significantly the highest hundred kernel weight and found superior to CO-3, TG 42 and VRI-2.

Groundnut cultivar B 95 produced the highest hundred kernel weight which was comparable with GG 5 (Subrahmaniyam and Kalaiselvam, 2006).

Banik *et al*. (2009) conducted a field experiment at Bidhan Chandra Krishi Vishwavidyalaya West Bengal and concluded that the maximum test weight was recorded with TAG-24 variety when compared to other varieties.

Soumya *et al.* (2011) reported that the hundred kernel weight was significantly higher with kadiri-6 than narayani on sandy loam soils of Rajendranagar, Hyderabad, during *kharif*.

Aruna and Karuna Sagar (2018) conducted an experiment at Agricultural Research Station Utukur, Kadapa of Andhra Pradesh to evaluate the efficacy of *rhizobium* inoculation along with fertilizers in popular varieties of groundnut and reported that dharani variety recorded the highest 100 kernel weight (35.61 g).

A field trial carried out by Mouri *et al.* (2018) at Bangladesh Agricultural University and stated that BARI Cheenabadam-8 produced significantly higher test weight (44.47 g) than BINA Cheenabadam-6.

2.3 EFFECT OF VARIETIES ON YIELD OF GROUNDNUT

2.3.1 Kernel Yield (kg ha^{-1})

Jamal *et al.* (2006) conducted a field experiment at New Delhi and inferred that application of 43.5 kg N ha^{-1} increased seed yield by 104 % in PK-1024 compared to control.

Banik *et al.* (2009) conducted a field experiment at Bidhan Chandra Krishi Vishwavidyalaya West Bengal and reported significantly highest kernel yield (27.95 q ha^{-1}) with variety TG-51 and it was found superior to other varieties studied.

The results of the experiment conducted by Nirmal *et al.* (2015) on sandy loamy soils revealed that the highest kernel yield was recorded with variety HNG 10 compared to TG 37A.

A field experiment conducted by Shendage *et al*. (2018) at College of Agriculture, Kolhapur revealed that the kernel yield was the maximum in variety JL-501compared to TAG-24.

Raagavalli *et al*. (2019) conducted a field experiment at AHRS, Bavikere, UAHS, Shivamogga, Karnataka and concluded that genotype GKVK-5 recorded the highest kernel yield (12.17 q ha^{-1}).

2.3.2 Pod Yield (kg ha^{-1})

The highest pod yield recorded with TAG-24 was significantly higher than that of LGN-2 in medium deep clay soils of Parbani, Maharashtra, during *rabi* (Jadhav *et al*., 2000).

A field trail conducted by Bharatha Lakshmi and Sambasiva Reddy (2001) revealed that pod yield was higher with variety JL-24 followed by TMV-2 and TPT-2 on sandy loam soils of Tirupati, Andhra Pradesh.

Groundnut pod yield recorded highest with ICGS-49 was comparable with ICGS-44 during summer and *kharif* seasons (Samui *et al*., 2004).

In an experiment conducted at Parbani, Maharashtra on medium deep clayey soils during *rabi*, the variety TAG-24 recorded significantly higher pod yield as compared to other varieties examined (Karanjikar *et al*., 2005).

Among the different varieties evaluated, the variety ASK 2002-7 recorded the highest pod yield followed by ASK 2003-3, ASK 2002-11 and ALR-2 during *rabi* on sandy loam soils of Aliyarnagar, Tamil Nadu (Chandrasekaran *et al*., 2007).

Ramesh and Sambasiva Reddy (2007) reported that groundnut variety K-134 recorded higher pod yield than TMV- 2, TPT-2 and TAG-24 during *rabi* season under irrigated conditions.

Banik *et al.* (2009) conducted a field experiment at Bidhan Chandra Krishi Vishwavidyalaya West Bengal to study the effect of dates of sowing on growth and yield of groundnut and reported the highest pod yield (52.17 qha^{-1}) with variety TG-51.

Soumya *et al*. (2011) reported that the pod yield was significantly higher with variety Kadiri- 6 compared to JCG-88 and ICGV-91114 on sandy loamy soils of Rajendranagar, Hyderabad, during *kharif*.

The results of the experiment conducted on sandy loam soil of Tirupati, Andhra Pradesh, during early *kharif* under irrigated conditions revealed that the variety dharani produced higher pod yield than greeshma (Krishna Reddy *et al*., 2013).

Reddy *et al*. (2014) conducted a field experiment at University of Agricultural Sciences Bangalore and reported that kaushal variety recorded the highest pod yield than chitra variety.

The results of the experiment conducted by Nirmal *et al.* (2015) on sandy loamy soils inferred that the highest pod yield, was recorded with variety HNG 10 compared to TG 37A.

Aruna and Karuna Sagar (2018) conducted an experiment at Agricultural Research Station Utukur, Kadapa to evaluate the efficacy of *rhizobium* inoculation along with fertilizers in popular varieties of groundnut and reported that dharani variety recorded the highest pod yield (4077 kg ha^{-1}) compared to K-6 variety.

Raagavalli *et al*. (2019) conducted a field experiment at AHRS, Bavikere, UAHS, Shivamogga and concluded that genotype GKVK-5 recorded the highest pod yield (16.73 qha^{-1}).

2.3.3 Haulm Yield (kg ha^{-1})

Haulm yield obtained with LGN-2 was significantly higher as compared to TAG-24 on medium deep black soils of Parbani, Maharashtra during *rabi* (Jadhav *et al*., 2000).

Haulm yield obtained with JL-24 was significantly higher as compared to TMV-2 and Tirupati-2 on sandy loam soils of Tirupati, Andhra Pradesh, under rainfed conditions (Bharatha Lakshmi and Sambasiva Reddy, 2001).

Groundnut haulm yield was recorded the highest with ICGS-49 and found comparable with ICGS-44 during summer and *kharif* seasons (Samui *et al*., 2004).

Ramesh and Sambasiva Reddy (2007) reported that groundnut variety K-134 recorded higher haulm yields than TMV- 2, TPT-2 and TAG-24 during *rabi* season under irrigated conditions.

Soumya *et al*. (2011) reported that the haulm yield was significantly higher with variety kadiri-6 than JCG-88 and ICGV-91114, on sandy loam soils of Rajendranagar, Hyderabad, during *kharif*.

The results of the experiment conducted by Nirmal *et al.* (2015) on sandy loamy soils concluded that the highest haulm yield was recorded with variety HNG 10 compared to TG 37A.

Aruna and Karuna Sagar (2018) conducted an experiment at Agricultural Research Station Utukur, Kadapa to evaluate the efficacy of *rhizobium* inoculation along with fertilizers in popular varieties of groundnut and reported that dharani variety has recorded the highest haulm yield (6929 kg ha^{-1}) compared to K-6 variety.

2.3.4 Shelling Percentage (%)

Jadhav *et al*. (2000) stated that the shelling percentage of TAG-24 was significantly higher as compared to LGN- 2 during *rabi* in medium deep clay soils of Parbani, Maharashtra.

The shelling percentage obtained with JL-24 was significantly higher as compared to TMV-2 and Tirupati-2 at Tirupati, Andhra Pradesh, on sandy loamy soils during rainfed season (Bharatha Lakshmi and Sambasiva Reddy, 2001).

Bharud and Pawar (2005) observed that the shelling percentage was significantly higher with the variety TAG-24 than JL-286 and RHRG-100 , tried during summer at Rahuri, Maharashtra.

A field experiment conducted by Kathirvelan and Kalaiselvan (2006) at Tamil Nadu Agricultural University, Coimbatore revealed that CO-3 groundnut variety recorded significantly the highest shelling percentage and found superior to other varieties tried.

Among the different varieties evaluated, the groundnut variety ASK 2002-7 produced the highest shelling percentage as compared to the rest of the varieties during *rabi* on sandy loam soils of Aliyarnagar, Tamil Nadu (Chandrasekaran *et al*., 2007).

Howlander *et al*. (2009) reported that the shelling percentage was significantly higher with Dhaka-1 as compared to DG-2 at Bangladesh on loamy soils during *rabi* season.

Banik *et al*. (2009) conducted a field experiment at Bidhan Chandra Krishi Vishwavidyalaya, West Bengal and reported highest shelling percentage in groundnut with TMV-2 variety.

Krishna Reddy *et al*. (2013) reported that the groundnut variety dharani recorded significantly higher shelling percentage compared to greeshma during early *kharif* in sandy loam soils of Tirupati, Andhra Pradesh.

A field experiment carried out by Patil *et al*. (2014) during *rabi* season to study the response of groundnut varieties to nutrient management and reported that maximum shelling percentage (72.4 %) observed with TAG-24 compared to other varieties.

Mouri *et al.* (2018) conducted a field experiment at Bangladesh Agricultural University and revealed that BARI Cheenabadam-8 produced significantly higher shelling percentage (81.84%) than BINA Cheenabadam-6.

Raagavalli *et al*. (2019) conducted a field experiment at AHRS, Bavikere, UAHS, Shivamogga, Karnataka and concluded that genotype GKVK-5 recorded highest shelling per cent (72.6).

2.3.5 Harvest Index (%)

Jadhav *et al*. (2000) reported that the harvest index of TAG-24 was higher as compared to LGN-2 in medium deep clay soils of Parbani, Maharashtra during *rabi*.

Bharud and Pawar (2005) reported that the harvest index was significantly higher with the variety TAG-24 than JL-286 and RHRG-10014 observed at Rahuri, Maharashtra, during summer.

Jadhav *et al*. (2000) reported that the harvest index of TAG-24 was higher as compared to LGN-2 in medium deep clay soils of Parbani, Maharashtra during *rabi*.

Soumya *et al*. (2011) reported that the variety, narayani recorded the highest harvest index followed by kadiri-6, JCG-88 and ICGV-91114 on sandy loam soils of Rajendranagar, Hyderabad, during *kharif*.

Mouri *et al.* (2018) conducted a field experiment at Bangladesh Agricultural University and revealed that BARI Cheenabadam-8 produced significantly higher harvest index (30.45%) than BINA Cheenabadam-6.

2.4 EFFECT OF LEVELS OF NITROGEN ON GROWTH PARAMETERS OF GROUNDNUT

2.4.1 Plant Height (cm)

Biswas *et al.* (2003) carried out a field experiment to investigate the effect of different levels of Bradyrhizobial inoculum and nitrogen on nodulation, growth, yield and N content in seed of groundnut and revealed that application of nitrogen @ 50 kg ha^{-1}recorded the highest plant height.

Ali and Seyyed (2010) applied four levels of nitrogen to groundnut, *i.e.*, 0, 30, 60 and 90 kg ha^{-1} and concluded that 60 kg N ha^{-1} resulted in highest plant height (38.2 cm) compared to other treatments.

Begum *et al.* (2015) conducted an experiment at Bangladesh Agricultural University, Mymensingh and inferred that application of 25kg N ha^{-1} recorded significantly the highest plant height.

Results of the experiment conducted by Chaudhary *et al.* (2015) to study the effect of integrated nutrient management on growth and yield attributes of summer groundnut revealed that application of 125 % RDN through vermicompost produced the highest plant height of 30.5 and 43.9 cm at 60 days after sowing (DAS) and at harvest, respectively.

Sengupta *et al.* (2016) conducted an experiment at District Seed Farm, Kalyani, West Bengal, and they reported that plant height of groundnut increased towards maturity with increasing levels of fertilizers either as basal or split doses along with FYM @ 7.5 t ha $^{-1}$. Application of 150% RDF as basal was reported to show the highest increase in height to 53.7 cm compared to other treatments.

A field experiment was carried out during *rabi* season by Bairagi *et al*. (2017) at SHIATS Allahabad on alluvial soils revealed that application 100% N P K + 100% gypsum significantly increased plant height compared to other fertilizer treatments.

Bekle *et al*. (2019) conducted a field experiment at East Hararghe Zone, Babile district and reported that highest plant height of groundnut was recorded with application of 23 kg N ha^{-1}.

2.4.2 Number of Branches Plant^{-1}

Gogoi *et al.* (2000) compared the response of different levels of N *viz.*, 0, 20, 40, 60 and 80 kg ha^{-1} to groundnut and found that increased level of nitrogen application upto 80 kg ha^{-1} increased the number of branches plant^{-1}.

Begum *et al*. (2015) conducted an experiment at Bangladesh Agricultural University, Mymensingh to study the effects of nitrogen and phosphorus on the performance of soybean and inferred that application of 25kg N ha^{-1} recorded more number of branches plant^{-1}.

A field trial was carried out during *rabi* season by Bairagi *et al*. (2017) at SHIATS Allahabad on alluvial soils revealed that application of 100% N P K + 100% gypsum significantly increased number of branches plant^{-1}compared to other fertilizer treatments.

2.4.3 Drymatter Accumulation (kg ha^{-1})

Biswas *et al.* (2003) carried out field experiment to investigate the effect of different levels of Bradyrhizobial inoculum and nitrogen on nodulation, growth, yield and N content in seed of groundnut and revealed that application of N @ 50 kg/ha recorded highest drymatter production.

Meena *et al.* (2011) reported that application of N @ 60 kg ha^{-1} resulted in the highest accumulation of drymatter (21.1 gplant^{-1}) as compared to 0, 20 and40 kg N ha$^{-1.}$

Yakadri *et al*. (2012) conducted a field experiment at College of Agriculture Rajendranagar to study the effect of nitrogen and phosphorus on growth and yield of greengram (*Vigna radiata.* L) and stated that application of nitrogen @ 20 kg ha^{-1} increased drymatter production.

Sengupta *et al.* (2016) conducted an experiment at District Seed Farm, Kalyani, West Bengal and observed that drymatter accumulation was found to be highest at 100 % RDF as basal along with 7.5 t ha^{-1} FYM (501.6 g m^{-2}) but it was statistically on par up to 150 % RDF as basal along with 7.5 t ha^{-1} FYM (497.7 g m^{-2}).

2.5 EFFECT OF LEVELS OF NITROGEN ON YIELD ATTRIBUTES OF GROUNDNUT

2.5.1 Number of Pods Plant^{-1}

Gogoi *et al.* (2000) compared the response of different levels of N *viz.*,0, 20, 40, 60 and 80 kg ha^{-1} to groundnut and found that increased level of nitrogen application upto 80 kg ha^{-1} increased the number of pods plant^{-1}.

Ranjit and Rai (2003) conducted a field experiment at Indian Agricultural Research Institute, New Delhi, to study the effect of integrated nutrient management in soybean (*Glycine max*) on its yield attributes, and revealed that combined application of NPK+ FYM+ Biofertilizer recorded highest number of pods plant^{-1} (38.45).

Hossian and Hamid (2008) stated that application of NP fertilizers @ 60-60 kg ha^{-1} (N/P fertilizer ratio of 1.00) recorded significantly higher number of mature pods plant^{-1}.

Ali and Seyyed (2010) applied four levels of nitrogen to groundnut, *i.e.*, 0, 30, 60 and 90 kg ha^{-1} and concluded that 60 kg N ha^{-1} resulted in highest number of pods plant^{-1} (31.1) compared to other treatments.

Reddy *et al.* (2011) stated that highest yield attributes was produced with 60 kg Nha^{-1} as compared to 45kg N ha^{-1} and 30kg N ha^{-1} in terms of number of pods plant^{-1} (49.5).

EI-Habbasha *et al.* (2013) conducted a field experiment at National Research Centre Nubaria District, Egypt on sandy soils of Egypt and stated that increasing nitrogen levels from 30-40 kg N/feddan significantly increased the number of pods/plant/ feddan (1 feddan = 0.42 ha).

Shivakumar *et al*. (2014) conducted a field experiment at Dharwad and revealed that the treatment receiving N/P fertilizer ratio of 0.50 (30 kg N, 60 kg P_2 O_5, 25 kg K_2 O ha^{-1}) produced significantly higher number of pods plant^{-1} (18.80) which was on par with N/P fertilizer ratio (0.42).

A field experiment conducted by Gunri *et al.* (2015) on alluvial soils of West Bengal inferred that application of 125% RDF recorded highest number of pods plant^{-1} which was on par with 75 % RDF and 100% RDF.

The results of the experiment conducted by Chaudhary *et al.* (2015) to study the effect of integrated nutrient management on growth and yield attributes of summer groundnut revealed that application of 125 % RDN through vermicompost produced the highest number of total pods plant^{-1}(31.5).

Paul *et al*. (2016) observed drip fertigation of water soluble fertilizers at 50 per cent RDF along with foliar spray of water soluble fertilizers at 12.5 per cent RDF in groundnut recorded significantly higher number of pods plant^{-1} (35.7) at GKVK, University of Agricultural Sciences, Bengaluru.

2.5.2 Number of Filled Pods Plant^{-1}

Reddy *et al.* (2011) stated that highest yield attributes was produced with 60 kg Nha^{-1} as compared to 45kg N ha^{-1} and 30kg N ha^{-1} in terms of number of filled pods plant^{-1} (29.8).

Shivakumar *et al*. (2014) conducted a field experiment at Main Agricultural Research Station (MARS), Dharwad and revealed that the treatment receiving N/P fertilizer ratio of 0.50 (30 kg N, 60 kg P_2 O_5, 25 kg K_2 O ha^{-1}) produced significantly maximum number of filled pods plant^{-1} (17.47).

Begum *et al*. (2015) conducted an experiment at Bangladesh Agricultural University, Mymensingh and inferred that application of 25kg N ha^{-1} recorded highest number of filled pods plant^{-1}.

2.5.3 Number of Kernels Pod^{-1}

Meena *et al.* (2011) revealed that application of 60 kg N ha^{-1} have resulted in significantly highest number of kernels pod^{-1} (2.2).

2.5.4 100 Kernel weight (g)

Ranjit and Rai (2003) conducted a field experiment at Indian Agricultural Research Institute, New Delhi, to study the effect of integrated nutrient management in soybean (*Glycine max*) on its yield attributes, and revealed that combined application of NPK+ FYM+ Biofertilizer recorded highest 100 seed weight compared to control.

Hossian and Hamid (2008) stated that application of NP fertilizers @ 60-60 kg ha^{-1} (N/P fertilizer ratio of 1.00) recorded significantly higher 100-kernel weight and better morphological characters that eventually resulted in greater pod yield.

Reddy *et al.* (2011) stated that highest test weight (62.2 g) was produced with 60 kg N ha^{-1} as compared to 45kg N ha^{-1} and 30kg N ha^{-1}.

The results of the investigation conducted by Ali and Ebrahim (2011) showed that maximum test weight (40g) was obtained with application of nitrogen @ 60 kg ha^{-1}.

Meena *et al.* (2011) revealed that application of 60 kg N ha^{-1} have resulted in significantly highest test weight (354.7g).

A field experiment conducted by Deshmukh *et al*. (2012) to study the response of groundnut (*Arachis hypogaea* L.) to irrigation and nitrogen fertilizers at Experimental Farm, College of Agriculture, Pune revealed that application of 100% RDN through urea, and full recommended dose of P_2O_5 and K_2O at the time of sowing recorded significantly highest 100 kernel weight (56.61 g).

Shivakumar *et al.* (2014) conducted a field experiment at Main Agricultural Research Station (MARS), Dharwad and revealed that treatment receiving N/P fertilizer ratio of 0.50 (30 kg N, 60 kg P_2 O_5, 25 kg K_2 O ha-1) produced significantly higher 100 kernel weight (38.50 g).

Gunri *et al.* (2015) conducted a field experiment at Bidhan Chandra Krishi Vishwavidyalaya on alluvial soils and inferred that application of 100% RDF recorded highest test weight than 50% RDF.

Begum *et al.* (2015) conducted an experiment at Bangladesh Agricultural University, Mymensingh to study the effects of nitrogen and phosphorus on the performance of soybean and inferred that application of 25kg N ha^{-1} recorded highest 1000-seed weight.

2.6 EFFECT OF LEVELS OF NITROGEN ON YIELD OF GROUNDNUT

2.6.1 Pod Yield (kg ha^{-1})

Biswas *et al.* (2003) carried out a field experiment to investigate the effect of different levels of Bradyrhizobial inoculum and nitrogen on nodulation, growth, yield and N content in seed of groundnut and revealed that application of nitrogen @ 50 kg/ha recorded highest pod yield.

A field experiment carried by Hossaian *et al.* (2007) at Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur inferred that the highest pod yield was recorded with application of 60 kg N ha^{-1} than 40 kg N ha^{-1}.

Hossian and Hamid (2008) stated that application of NP fertilizers @ 60-60 kg ha^{-1} (N/P fertilizer ratio of 1.00) recorded significantly better morphological characters that eventually resulted in greater pod yield.

The results of the experiment conducted by Elayaraja and Singaravel (2009) on sandy loam soils of Madras revealed that application of 150% NPK levels and composted coirpith @ 12.5 t ha^{-1} recorded highest pod yield 2196 kg ha^{-1}.

A field experiment was conducted by Ali and Seyyed (2010) in Astaneh Ashrafiyeh, North of Iran. reported that use of 60 kg N ha^{-1} resulted in the highest pod yield of 2314 kg ha^{-1}.

The results of the experiment conducted by Pendashteh *et al*. (2011) at Islamic Azad University, Lahijan, Iran inferred that significantly highest pod yield was found with application of 80 kg N ha^{-1}.

The results of the investigation conducted by Ali and Ebrahim (2011) showed that maximum kernel yield (1796 kg ha^{-1}) was obtained with application of nitrogen @ 60 kg ha^{-1}.

Reddy *et al.* (2011) stated that highest pod yield (2244 kg ha^{-1}) was produced with 60 kg N ha^{-1} as compared to 45kg N ha^{-1} and 30kg N ha^{-1}.

Yakadri *et al.* (2012) conducted a field experiment at College of Agriculture Rajendranagar to study the effect of nitrogen and phosphorus on growth and yield of greengram (*Vigna radiata*. L) and reported that application of nitrogen @ 20 kg ha^{-1} increased number of pods.

EI-Habbasha *et al.* (2013) carried out field experiment at National Research Centre, Nubaria District, Egypt on sandy loam soils during the two successive summer seasons and stated that increasing nitrogen levels from 30-40 kg N/feddan significantly increased pod yield/feddan (1 feddan = 0.42 ha).

Shivakumar *et al*. (2014) conducted a field experiment at Main Agricultural Research Station (MARS), Dharwad and revealed that the treatment receiving N/P fertilizer ratio of 0.50 (30 kg N, 60 kg P_2 O_5, 25 kg K_2 O ha^{-1}) produced significantly higher pod yield (3310 kg ha^{-1}).

Khonok *et al*. (2015) concluded that among the different levels of nitrogen fertilizer (0, 30, 60 and 90 kg N ha^{-1}), application of 60 kg N ha^{-1} resulted in maximum amount of pod yield with 2667 kg ha^{-1}.

The results of the experiment conducted by Nirmal *et al.* (2015) on sandy loamy soils stated that the highest pod yield was recorded with 30 kg N ha^{-1} than 20 kg N ha^{-1}.

Gunri *et al.* (2015) conducted a field experiment at Bidhan Chandra Krishi Vishwavidyalaya on alluvial soils and inferred that application of 100% RDF recorded highest pod yield than 50% RDF.

Paul *et al*. (2016) observed that drip fertigation of water-soluble fertilizers at 50 per cent RDF along with foliar spray of water-soluble fertilizers at 12.5 per cent RDF in groundnut recorded significantly maximum pod yield (2910 kg ha^{-1}) at GKVK, University of Agricultural Sciences, Bengaluru.

A field experiment conducted by Parameshwarareddy *et al.* (2019) at Main Agricultural Research Station Dharwad during summer stated that application of 125% RDF recorded significantly highest pod yield (39.2 q ha^{-1}) over 100% RDF (36.47 q ha^{-1}).

2.6.2 Kernel Yield (kg ha^{-1})

Singh *et al.* (2001) conducted a field experiment at Rajasthan Agricultural University Udaipur on soybean (*Glycine max*) and revealed that application of 60 kg N ha^{-1} increased seed yield by 22.1% over 30 kg N ha^{-1}.

Jamal *et al.* (2006) conducted a field experiment at Department of Biotechnology New Delhi on two cultivars of groundnut *Arachis hypogaea* cv Amber and *Arachis hypogaea* cv Kaushal and revealed that application of 43.5 kg N ha^{-1} increased seed yield of kaushal variety by 79 % compared to control.

A field experiment conducted by Ali and Seyyed (2010) in Astaneh Ashrafiyeh, North of Iran reported that use of 60 kg N ha^{-1} resulted in the highest kernel yield1378 kg ha^{-1}.

The results of the experiment conducted by Pendashteh *et al*. (2011) at Islamic Azad University, Lahijan, Iran inferred that the highest seed yield or kernel yield was found with application of 80 kg N ha^{-1}.

Yakadri *et al.* (2012) conducted a field experiment at College of Agriculture Rajendranagar to study the effect of nitrogen and phosphorus on growth and yield of greengram (*Vigna radiata* L) and revealed that application of nitrogen @ 20 kg ha^{-1} increased number of seeds.

Shivakumar *et al.* (2014) conducted a field experiment at Dharwad and revealed that the treatment receiving N/P fertilizer ratio of 0.50 (30 kg N, 60 kg P_2O_5, 25 kg K_2O ha^{-1}) produced significantly higher kernel yield (2441 kg ha^{-1}) and was on par with N/P fertilizer ratio treatment of 0.33 (2344 kg ha^{-1}).

The results of the experiment conducted by Nirmal *et al.* (2015) on sandy loamy soils during *kharif* season reported that the highest kernel yield was recorded with 30 kg N ha^{-1} than 20 kg N ha^{-1}.

Khonok *et al.* (2015) concluded that among the different levels of nitrogen fertilizer (0, 30, 60 and 90 kg N ha^{-1}), application of 60 kg N ha^{-1} resulted in maximum kernel yield (2012.2 kg ha^{-1}).

2.6.3 Haulm Yield (kg ha^{-1})

The results of the experiment conducted by Elayaraja and Singaravel (2009) on sandy loam soils of Madras revealed that application of 150% NPK levels and composted coirpith @ 12.5 t ha^{-1} recorded the highest haulm yield (2930 kg ha^{-1}) respectively.

Reddy *et al.* (2011) stated that the highest haulm yield of groundnut (4094 kg ha $^{-1}$) was produced with 60 kg Nha^{-1} as compared to 45kg N ha^{-1} and 30kg N ha^{-1} haulm yield (4094 kg ha $^{-1}$).

The results of the experiment conducted by Nirmal *et al.* (2015) on sandy loamy soils during *kharif* season concluded that the highest haulm yield was recorded with 30 kg N ha^{-1} than 20 kg N ha^{-1}.

Gunri *et al.* (2015) conducted a field experiment at Bidhan Chandra Krishi Vishwavidyalaya on alluvial soils and inferred that application of 100% RDF recorded the highest haulm yield over 50% RDF.

Paul *et al*. (2016) observed that drip fertigation of water soluble fertilizers at 50 per cent RDF along with foliar spray of water soluble fertilizers at 12.5 per cent RDF in groundnut recorded significantly higher haulm yield (2843 kg ha^{-1}) at GKVK, University of Agricultural Sciences, Bengaluru.

2.6.4 Shelling Percentage (%)

Reddy *et al.* (2011) stated that highest shelling percentage (69.73), was observed with 60 kg Nha^{-1} as compared to 45kg N ha^{-1} and 30kg N ha^{-1}.

Meena *et al.* (2011) revealed that application of 60 kg N ha^{-1} have resulted in significantly the highest shelling percentage (66.2 %).

A field experiment conducted by Deshmukh *et al*. (2012) to study the response of groundnut (*Arachis hypogaea* L.) to irrigation and nitrogen fertilizers at Experimental Farm, College of Agriculture, Pune revealed that application of 100% RDN through urea, and full recommended dose of P_2O_5 and K_2O at the time of sowing recorded significantly the highest values for shelling per cent (76.12 %).

Gunri *et al.* (2015) conducted a field experiment at Bidhan Chandra Krishi Vishwavidyalaya on alluvial soils and inferred that application of 100% RDF recorded the highest shelling percentage than 50% RDF.

Paul *et al*. (2016) observed that drip fertigation of water-soluble fertilizers at 50 per cent RDF along with foliar spray of water-soluble fertilizers at 12.5 per cent RDF in groundnut recorded significantly higher shelling percentage (75.4 %) at GKVK, University of Agricultural Sciences, Bengaluru.

2.6.5 Harvest Index (%)

A field experiment conducted by Deshmukh *et al*. (2012) to study the response of groundnut (*Arachis hypogaea* L.) to irrigation and nitrogen fertilizers at Experimental Farm, College of Agriculture, Pune revealed that application of 100% RDN through urea, and full recommended dose of P_2O_5 and K_2O at the time of sowing recorded significantly highest values for harvest index (45.32) and was at par with that of 75% RDN + 25% N through vermicompost.

Khonok *et al*. (2015) concluded that among the different levels of nitrogen fertilizer (0, 30, 60 and 90 kg N ha^{-1}), application of 60 kg N ha^{-1} resulted in maximum biological yield with an average of 7519.8 kg ha^{-1}.

2.7 EFFECT OF VARIETIES AND NITROGEN LEVELS ON QUALITY PARAMETERS OF GROUNDNUT

2.7.1 Quality Parameters

Ranjit and Rai (2003) conducted a field experiment at Indian Agricultural Research Institute, New Delhi, to study the effect of integrated nutrient management in soybean (*Glycine max*) on its yield attributes, seed yield and quality attributes and revealed that the highest protein content was recorded in treatment receiving NPK+ FYM +crop residue (39.43 %) while the highest oil content was recorded in the treatment receiving NPK+ FYM + Biofertilizer.

Brar *et al*. (2004) reported that the oil content was not influenced by varieties, SG-84 and M-522 of groundnut on loamy sand soils of Ludhiana, Punjab, under rainfed conditions.

Jamal *et al.* (2006) conducted a field experiment at New Delhi on two cultivars of soybean (*G. max (*L.) Merr.) cv. PK-416 (V_1), cv. PK-1024 (V_2) and inferred that application of 43.5 kg N ha^{-1} increased oil yield by 123% in V_2 (PK-1024) compared to control.

Jamal *et al.* (2006) conducted a field experiment at New Delhi on two groundnut varieties and reported that kaushal variety recorded highest oil yield, protein yield 2277 kg ha^{-1} and 137.2 % respectively.

Morshed *et al.* (2008) conducted a pot experiment to study the effect of nitrogen on seed yield, protein content and nutrient uptake of soybean and results revealed that protein content in seeds increased with increasing levels of N (up to the same rate of 26.45 kg N ha^{-1}).

Dhaka-1 recorded the highest oil content compared to DG-2 at Bangladesh on loamy soils during *rabi* season (Howlander *et al*., 2009).

Narayani among the ground varieties recorded significantly the highest oil yield as compared to the rest of the varieties on sandy loam soils during *kharif* season at Rajendranagar, Hyderabad (Soumya *et al*., 2011).

Kharade *et al*. (2013) noticed that application of 30 kg N, 50 kg P_2O_5 and 45 kg K_2O ha^{-1} along with Biofertilizer significantly increased oil yield and protein content in kernels over rest of all the treatment due to increased transfer of N from haulm to kernel due to application of K and increased nitrogen metabolism leading to high protein formation

Sharma *et al*. (2014) conducted a field experiment during *kharif* season at the Agronomy farm, S.K.N College of Agriculture, Jobner. The results revealed that Rhizobium inoculation along with inorganic fertilizers resulted in significantly higher oil content (13.3 %) in kernel and oil yield (41.8%) over the control.

A field experiment carried out by Patil *et al*. (2014) during rabi season to study the response of groundnut varieties to nutrient management reported that the highest oil content (48.9%) and protein content (27.5%) was recorded in TAG-24 compared to other varieties.

2.8 EFFECT OF LEVELS OF NITROGEN ON SOIL PROPERTIES AND NITROGEN UPTAKE OF GROUNDNUT

2.8.1 Soil Properties

Bairagi *et al.* (2017) conducted a field experiment during *rabi* season at the research farm of Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad and revealed that application of 100% N P K + 50% gypsum increased pH 7.37, EC 0.714 dSm^{-1}, Organic carbon 0.79%. whereas available nitrogen, phosphorus, potassium, were found more with application of 100% N P K + 100% gypsum.

2.8.2 Nitrogen Uptake

Morshed *et al.* (2008) conducted a pot experiment to study the effect of nitrogen on seed yield, protein content and nutrient uptake of soybean and results revealed that nutrient uptake increased with increasing levels of N (up to the same rate of 26.45 kg N ha^{-1}).

Deka *et al.* (2012) conducted an experiment to study the response of groundnut to lime and nitrogen and inferred that the highest uptake of nitrogen was recorded with 40kgN/ha.

Shivakumar *et al.* (2014) conducted a field experiment at Main Agricultural Research Station (MARS), Dharwad to study the effect of nitrogen and phosphorus levels and ratios on yield and nutrient uptake by groundnut in northern transition zone of Karnataka and revealed that the treatment receiving N/P fertilizer ratio of 0.50 (30 kg N, 60 kg P_2O_5, 25 kg K_2O ha^{-1}) produced significantly higher nutrient uptake compared to all other N/P fertilizer ratios.

Chakraborthy (2019) conducted an experiment at Agricultural College Farm, Bapatla during *kharif* season and found nitrogen uptake in seed (376.6 kg ha^{-1}) was significantly higher with 90 kg N ha^{-1} however, at pegging (79.9 kg N ha^{-1}) and flowering stage (28.2 kg N ha^{-1}) and it was on par with 60 kg N ha^{-1}.

2.9 EFFECT OF VARIETIES AND LEVELS OF NITROGEN ON ECONOMICS OF GROUNDNUT

2.9.1 Economics

Ramesh and Sambasiva Reddy (2006) while working with four groundnut varieties reported that maximum gross return, net return and benefit cost ratio with K-134 as compared to the rest of the varieties studied during *rabi* in sandy loam soils of Rajendranagar, Hyderabad.

Soumya *et al*. (2011) reported that the highest gross return, net return and benefit-cost ratio were obtained with groundnut variety narayani and closely followed by kadiri-6 as compared to ICGV-91114 during *kharif*.

Meena and Yadav (2015) conducted a field experiment at Agricultural University Bikaner to evaluate the yield and profitability of groundnut (*Arachis hypogaea* L.) as influenced by sowing dates and nutrient levels with different varieties and reported that variety HNG 10 recorded higher net returns (61843ha^{-1}).

Waghmode *et al*. (2017) reported that the maximum gross return (Rs 178199 ha^{-1}), net return (Rs 73637 ha^{-1}) and B:C ratio (1.76) were noticed by the use of 125% RDF fertilizer levels.

Chapter-III

MATERIAL AND METHODS

The present investigation entitled "**Potential performance of groundnut (*Arachis hypogaea* L.) cultivars to levels of nitrogen"** was conducted during *rabi* season, 2020 at the Agricultural College Farm, Bapatla. The materials used and the methods adopted during the experimentation are presented in this chapter.

3.1 LOCATION OF THE EXPERIMENTAL SITE

Agricultural College farm is situated at an altitude of 5.49 m above the Mean Sea Level (MSL), 15° 54´N latitude, 80° 30´E longitude and about 7 km away from the Bay of Bengal in the Krishna Agro-climatic Zone of Andhra Pradesh, India. The experiment was laid out in Field No.9, orchard block of the Agricultural College farm, Bapatla.

3.2 WEATHER

The growth and development of any crop is normally governed by weather parameters. These parameters, such as temperature, relative humidity and rainfall during the crop growth period are detailed in Table 3.1 and depicted in fig. 3.1 and 3.2.

During the crop growth period, the weekly mean maximum temperature ranged from 25.3^{o}C to 34.7^{o}C, with an average of 31.2 ^{o}C, while the mean minimum temperature ranged from 15.4^{o}C to 23.1^{o}C with an average of 19.5 ^{o}C. Similarly, the weekly mean relative humidity ranged from 48.0 to 96.1 %. A total rainfall of 23 mm was received during the crop growth period in a single rainy day.

Thus, the prevailing weather conditions being congenial for the growth and development of the groundnut crop did not display any adverse effect on their potential performance.

Table 3.1. Standard week wise mean meteorological data during the crop growth period of groundnut (10-12-2020 - 07-04-2021)

Standard Meteorological Week	Date and Month	Mean Temperature (^{0}C)		Mean R.H. (%)		Rainfall (mm)	No. of Rainy days
		Max.	Min.	8:30	17:30		
50	10th-16th Dec	29.8	18.2	87.5	55.4	-	-
51	17th- 23rd Dec	29.5	18.5	85.4	56.4	-	-
52	24th- 31st Dec	25.3	15.4	96.1	53.7	-	-
1	1st- 7th Jan	29.3	19.6	86.1	53.8	-	-
2	8th-14th Jan	30.8	20.5	85.2	64.0	-	-
3	15th - 21st Jan	31.5	19.5	85.2	56.7	-	-
4	22nd- 28th Jan	30.8	19.0	84.0	54.4	-	-
5	29th Jan- 4th Feb	30.8	19.1	85.1	53.8	-	-
6	5th- 11th Feb	30.7	17.4	85.1	48.1	-	-
7	12th -18th Feb	30.3	17.4	85.0	49.5	-	-
8	19th - 25th Feb	30.1	20.3	83.1	59.0	23	1
9	26th - 4th Mar	32.6	20.1	83.0	61.4	-	-
10	5th - 11th Mar	32.7	19.3	84.4	50.4	-	0
11	12th - 18th Mar	34.3	20.2	83.7	56.7	-	0
12	19th - 25th Mar	34.7	21.2	82.5	48.0	-	-
13	26th – 1st Apr	33.6	23.1	72.5	58.4	-	0
14	2nd - 8th Apr	34.1	22.4	83.4	56.4	-	0
¤	**Total**	-	-	-	-	23	1
	Mean	31.2	19.5	84.5	55.1	-	-

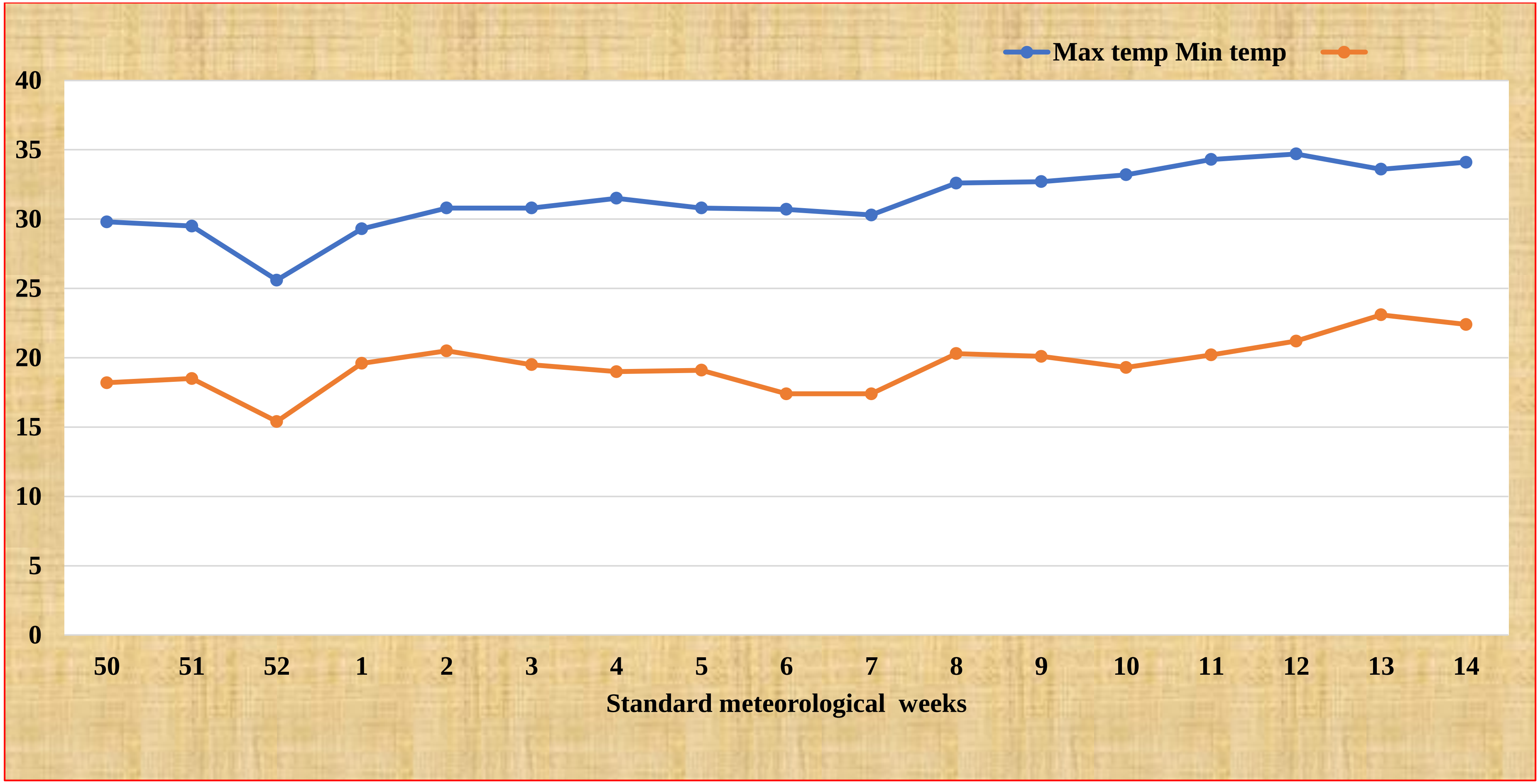

Fig. 3.1. **Weekly mean maximum and minimum temperatures (˚C) recorded during the crop growth period (10-12-2020 to 08-04-2021)**

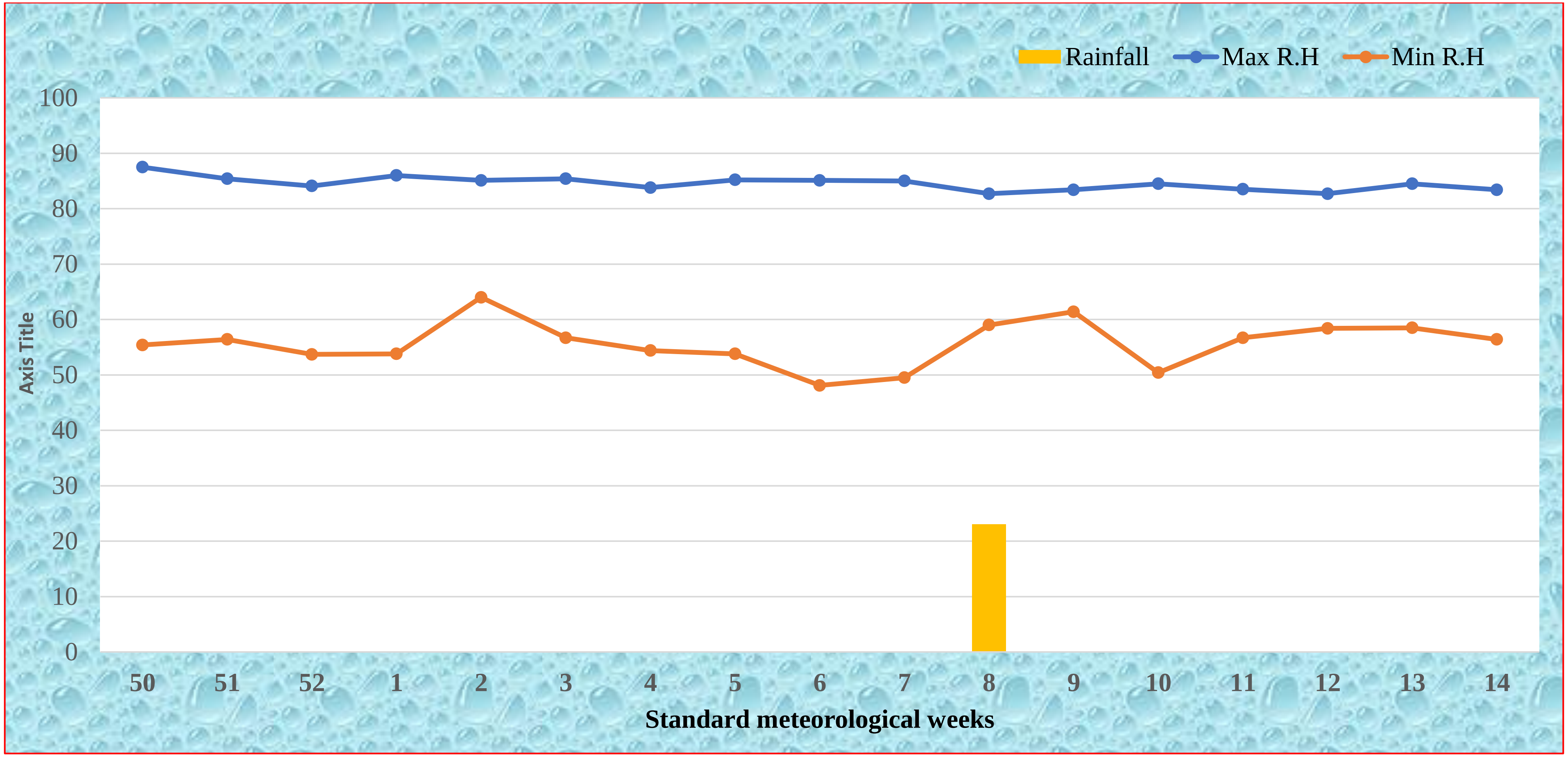

Fig. 3.2. Weekly mean maximum and minimum relative humidity (%) and mean rainfall (mm) recorded during the crop growth period (10-12-2020 to 08-04-2021)

3.3 SOIL

Composite soil sample from the experimental site were collected from 0-30 cm depth, thoroughly mixed and dried before conducting the experiment. A representative soil sample of about one kilogram was drawn by quartering method. The soil sample was analyzed for different physico-chemical properties (Table 3.2).

Table 3.2. Physico-chemical properties of the experimental soil

S. No.	Parameter	Unit	Value	Method
I	**Mechanical analysis**			
1	Sand	%	69	Bouyoucos hydrometer method (Piper, 1966)
2	Silt	%	21	
3	Clay	%	10	
4	Textural class	Sandy loam		
II.	**Chemical analysis**			
1	pH (1:2.5 Soil water suspension)	-	6.7	Glass electrode method (Jackson, 1973)
2	Electrical conductivity (1:2.5)	dS m^{-1}	0.27	Digital electrical conductivity meter (Jackson, 1973)
3	Organic Carbon	%	0.35	Walkley and Black's modified method (Walkley and Black, 1934)
4	Available N	kg ha^{-1}	180	Alkaline potassium permanganate method (Subbiah and Asija, 1956)
5	Available P_2O_5	kg ha^{-1}	26.2	Olsen's method (Olsen *et al.*, 1954)
6	Available K_2O	kg ha^{-1}	146.3	Neutral normal ammonium acetate method (Jackson, 1973)

The results of the analysis indicated that the experimental soil was sandy loam in texture, slightly acidic in pH, non-saline in nature, low in available nitrogen and organic carbon, medium in available K_2O and P_2O_5.

3.4 CROPPING HISTORY OF THE EXPERIMENTAL SITE

Details of the crops grown during the preceding three years in the experimental field are furnished below (Table 3.3).

Table 3.3. Cropping history of the experimental site

Year	Crop	
	kharif	***rabi***
2017-2018	Groundnut	Fallow
2018-2019	Maize	-
2019 – 2020	Groundnut	-
2020 – 2021	Sweet Corn	Groundnut

The experimental crop of groundnut was sown in *rabi* season during the year 2020-2021.

3.5 EXPERIMENTAL DETAILS

The experiment was laid out in a Randomized Block Design with Factorial Concept consisting of three cultivars and four nitrogen levels. Altogether these twelve treatments were replicated thrice. The layout plan of experiment is depicted in fig. 3.3.

3.5.1 Design and Layout

Location	:	Agricultural College Farm, Bapatla
Crop	:	Groundnut
Season	:	*rabi* (2020-2021)
Variety	:	Dharani (TCGS-1043), TAG -24 and Kadiri Lepakshi (K1812)
Design	:	Randomized Block Design with Factorial Concept
Replications	:	Three
Spacing	:	22.5 cm x 10 cm
Gross plot size	:	4.5 m x 4.0 m
Net plot size	:	3.6 m x 3.6 m

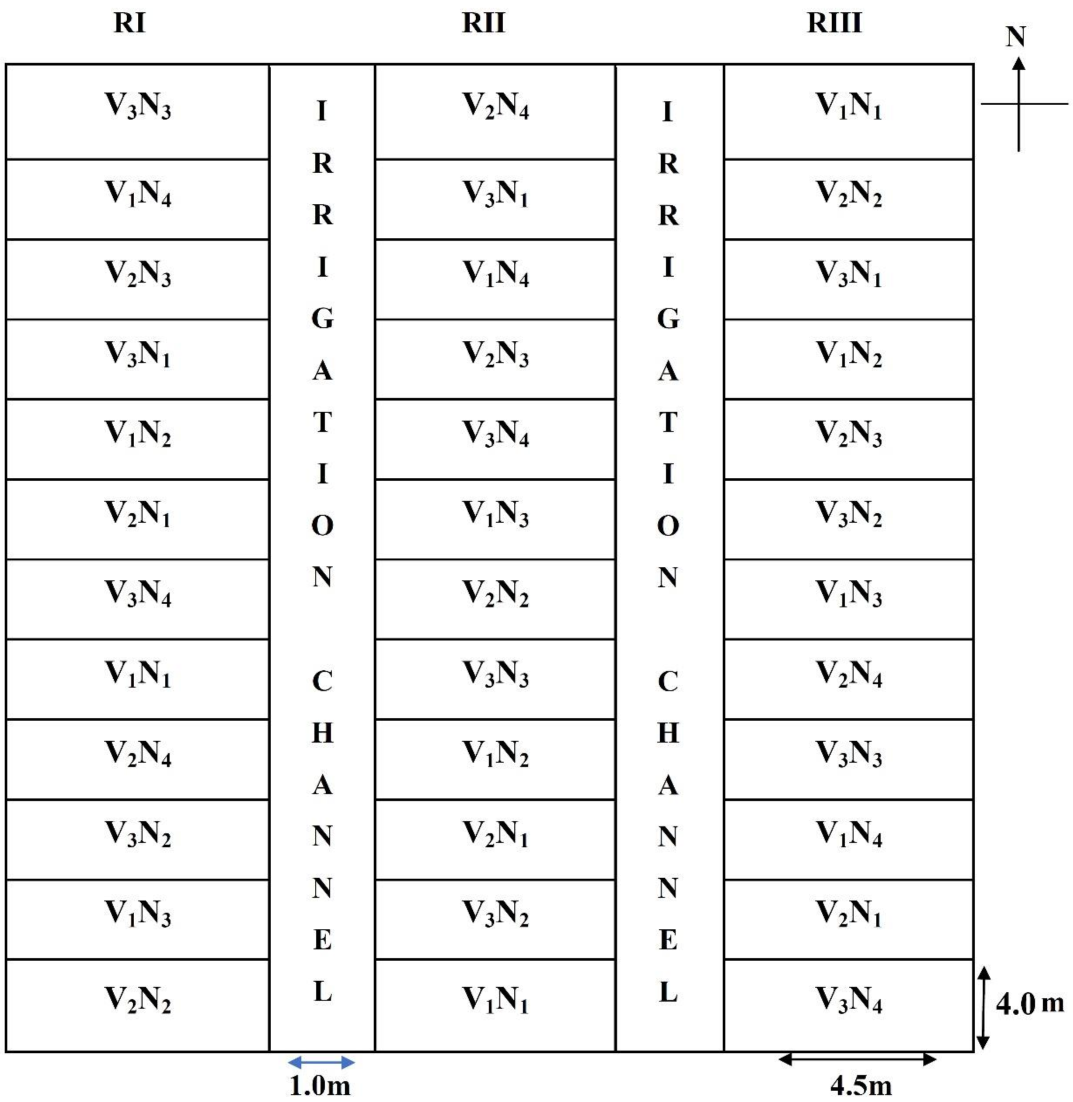

Fig. 3.3. Layout plan of experiment

FACTOR-1 (Groundnut cultivars)

V_1 - Dharani

V_2 – Kadiri Lepakshi

V_3 - TAG-24

FACTOR-2 (Nitrogen Levels)

N_1- 0 kg N ha^{-1}

N_2- 25kg N ha^{-1}

N_3 - 50 kg N ha^{-1}

N_4 - 75 kg N ha^{-1}

3.6 CULTIVAR DETAILS

3.6.1 TAG-24 (Trombay Akola Groundnut)

TAG-24 is a Spanish bunch type variety released for cultivation during 1992 from Maharashtra. It was developed by Baba Atomic Research Centre, Mumbai through hybridization with mutant TGS-2 obtained by irradiation with gamma rays and mutant TGE-1 obtained by irradiation with X-rays. Main yield attributes of the variety are earliness, semi-dwarf habit, yield stability, high harvest index, shorter internodes, dark green, small leaves and high water use efficiency. The crop has duration of 90-95 days with yield potential of 3000-3500 kg ha^{-1}.

3.6.2 Dharani

TCGS1043, released in 2013 as "Dharani" is a cross between VRI 2 and XTCGP-6. It has a duration of 100-105 days. In *kharif* season it is grown under rainfed condition producing 16-26 q ha^{-1} but in *rabi* season it produces 37-43 q ha^{-1}. It is drought tolerant with high water use efficiency, high mature kernel percentage, and is tolerant to stem rot, root rot and peanut bud necrosis disease.

3.6.3 Kadiri Lepakshi (K 1812)

Kadiri Lepakshi is a newly released groundnut variety from Agricultural Research Station Kadiri (K1812). The duration of this variety is 120 days and has yield potential of 2839 – 4275 kg ha^{-1}. It produces120-150 pods $plant^{-1}$. It is resistant to *Spodoptera litura* and tikka leaf spot disease. This variety exhibits dormancy which can be inhibited by treating with ethrel solution.

3.7 CULTIVATION DETAILS FOR GROUNDNUT

The details of cultivation practices are presented here under. The calendar of operations are furnished in Appendix I.

3.7.1 Field Preparation

An area of 830 m^2 was selected for conducting the experiment. The field was ploughed with tractor drawn cultivator and rotovator. After thorough levelling, the field was divided into number of plots as per the layout plan in fig. 3.5.

3.7.2 Sowing

Clean and bold seeds were selected and treated with carbendazim at the rate of 3g kg^{-1} of seeds, and imidacloprid @ 6ml kg^{-1} seed as a prophylactic measure against seed-borne diseases and pests like root grubs and rhizobium culture @ 6ml kg^{-1}seed for proper germination of seedlings. The seeds were dibbled at a depth of 3 to 4 cm adopting a spacing of 22.5 cm x 10 cm.

3.7.3 Fertilizer Application

Nitrogen was applied as per the treatment. Phosphorous and potassium were applied @ 40 kg ha^{-1} in the form of Singlesuper phosphate and 50 kg ha^{-1} in the form of Muriate of potash respectively as basal dose to all the treatments uniformly as band placement.

3.7.4 Gap Filling

Gap filling was accomplished 7 days after sowing in groundnut wherever necessary to maintain optimum plant population.

3.7.5 Intercultural Operations

For controlling weeds and also to keep the soil in a friable condition, two hand weedings were carried out to reduce competition by weeds. First hand weeding was carried out at 15 days after sowing this was followed by intercultivation at 20 days after sowing with hand hoe to reduce crusting of soil surface and to provide better aeration in soil. Second hand weeding was done at 10 days after first weeding to keep the field weed free. Earthing up was carried out during second manual weeding.

3.7.6 Irrigation

Irrigation was given once immediately after sowing for ensuring proper germination and plant stand. Thereafter three irrigations were given at flowering stage, pod formation stage and harvesting stage.

3.7.8 Plant Protection

During the crop growth period, *Spodoptera litura* damage was observed at 15-20 DAS and Peanut Bud Necrosis disease at 40 DAS and was controlled by spraying Novaluron and Thiomethoxam @ 0.2g lit^{-1}. Early tikka leaf spot disease observed at 40-70 DAS which was controlled by spraying tebuconazole @ 1.0 kg a.i ha^{-1}. Stem rot and root rot disease was controlled by drenching the plants twice with carbendazim + mancozeb @ 3g l^{-1}. Sucking pests like aphids, thrips and leaf miner were affectively controlled by spraying flonicamid @ 50 WG 60 g acre $^{-1}$ and chlorpyriphos @ 2ml lit^{-1}.

3.7.9 Harvesting and Stripping

The crop was considered to be matured, when more than 75% of the pods of the randomly picked plants showed dark streaks inside the shell. Border rows of each treatment were harvested first and treated as bulk. Randomly selected five plants in each net plot were harvested separately. The plants in the net plot were hand pulled separately and the pods were hand stripped. The collected pods were cleaned and sun dried to a constant weight. The pods and haulm of the sampled plants were added to the net plot produce to arrive at the pod and haulm yields per plot. The pod and haulm yield from each net plot were recorded separately and expressed as kg ha^{-1}.

3.8 BIOMETRIC OBSERVATIONS RECORDED

3.8.1 Sampling Technique

3.8.1.1 Destructive Sampling

For recording drymatter accumulation and nutrient uptake, which involved destructive sampling, five plants from the second row in the border row from each plot were selected. The samples were sun dried first followed by oven drying at 65^0C for about 48 hrs till the constant weight was attained and expreseed in kg ha^{-1}.

3.8.1.2 Non-Destructive Sampling

Five representative plants were selected from the net plot area of each treatment plot randomly and tagged. The biometrical and post-harvest observations were recorded on these tagged plants.

3.8.2 Pre-harvest Observations

3.8.2.1 Initial and Final Plant Population

Plant population m^{-2} was recorded at 15 DAS and at maturity by randomly placing a quadrant in three different places in a plot and number of plants per each of the three quadrants were averaged.

3.8.2.2 Plant Height (cm)

Height of five plants selected randomly from each plot was measured from base of the plant to top of the apical meristem at 30,60,90 DAS and at harvest**.** The average of five randomly selected plants was calculated and expressed as height of the plant in centimetre (cm).

3.8.2.3 Number of Branches Plant^{-1}

The number of branches from the five randomly selected plants was counted at 30,60,90 DAS and at harvest. The average of five plants was calculated and expressed as number of branches plant^{-1}.

3.8.2.4 Drymatter Accumulation (kg ha^{-1})

Five plants at random from gross plot without boarder effect kept for destructive sampling at 30,60,90 DAS and at harvest for the estimation of drymatter production. The plants were removed along with root system. The roots of samples were separated and shoots were sundried for 2 days and then dried in hot air oven at 60 ^{0}C to a constant weight and expressed as kg ha^{-1}.

3.8.2.5 Days to 50% Flowering

The number of days taken from the date of sowing to the stage when 50 per cent of the plants showed flowering in net plot area is considered as days to 50 per cent flowering.

3.8.2.6 Days to Maturity

Numbers of days taken to attain physiological maturity was recorded in each treatment as days to maturity.

3.8.2.7 Nodule Dry Weight (g plant^{-1})

Five plants were selected randomly at harvest from the rows meant for sampling from each plot. The whole plant was carefully uprooted using a spade so as to obtain intact roots and nodules for nodulation parameters. Uprooting was done by exposing the whole-root system to avoid loss of nodules. The adhering soil was removed by washing the roots with intact nodules gently with water over a metal sieve. The same five plants from each plot were used to record nodule dry weight (g plant^{-1}).

3.8.3 Post Harvest Observations

3.8.3.1 Number of Pods Plant^{-1}

The pods of individual plant from tagged plants were counted and average of five plants was recorded as number of pods plant^{-1} at maturity.

3.8.3.2 Number of Kernels pod^{-1}

The number of kernels from randomly selected pods were counted, averaged and expressed as number of kernels pod^{-1}.

3.8.3.3 100 Kernel Weight (g)

For this purpose, a random sample of seed from each treatment was drawn from the total produce after harvest. Hundred seeds were counted manually. The same was weighed and expressed in grams**.**

3.8.3.4 Shelling Percentage (%)

Random samples of fully developed pods were drawn, shelled, kernels were separated and weights recorded. The per cent of kernels to pods was worked out for each treatment with the following formula,

$$\text{Shelling per cent} = \frac{\text{Kernel weight (g)}}{\text{Pod weight (g)}} \text{ x } 100$$

3.8.3.5 Pod Yield (kg ha^{-1})

Pod yield plot^{-1} was recorded after thorough drying and separating pods from plant from each net plot area. The yield of five tagged plants were also added and expressed in kg ha^{-1}.

3.8.3.6 Haulm Yield (kg ha^{-1})

The haulms obtained from each net plot area along with five sampled plants were thoroughly sun dried, weighed and expressed in kg ha^{-1}.

3.8.3.7 Harvest Index

The harvest index for each treatment plot was calculated by using the following formula.

$$\text{HI} = \frac{\text{Economic yield (Pod yield) kg ha}^{-1}}{\text{Biological yield (Pod yield + Haulm yield)}} \text{ X } 100$$

3.9 CHEMICAL ANALYSIS

3.9.1 Soil Analysis

3.9.1.1 Collection and Preparation of Soil Samples

Soil samples were collected at a depth of 30 cm before and after harvest of the crop were shade dried, pounded with a pestle and mortar, passed through a 2 mm sieve and finally stored in labelled cloth bags for laboratory analysis. Processed soil samples were used for analysing various nutrients.

3.9.1.2 Soil Reaction (pH)

Soil reaction was determined in 1:2.5 soil water suspension using combined Glass electrode method (Jackson, 1973).

3.9.1.3 Electrical Conductivity (EC) (dS m^{-1})

The soluble salt content of soil samples was determined in 1:2.5 soil water suspension using Digital electrical conductivity meter (Jackson, 1973) and is expressed in dS m^{-1}.

3.9.1.4 Organic Carbon (%)

Organic carbon content of the soil from the experimental plot was determined by Walkley and Black’s modified method (Walkley and Black, 1934) and expressed in percentage.

3.9.1.5 Available Nitrogen (kg ha^{-1})

Available nitrogen content of the soil from the treated plot was determined by Alkaline potassium permanganate method (Subbiah and Asija, 1956) and expressed in kg ha^{-1}.

3.9.1.6 Available Phosphorus (kg ha^{-1})

Available phosphorus of the soil samples was extracted with 0.5 M $NaHCO_3$ of pH 8.5 and the phosphorus in the extract was estimated calorimetrically by ascorbic acid method using a spectrophotometer at 660 nm through Olsen's method (Olsen *et al.*, 1954) and expressed in kg ha^{-1}.

3.9.1.7 Available Potassium (kg ha^{-1})

Available potassium of the soil was extracted using neutral normal ammonium acetate method (Jackson, 1973) and potassium in the extract was determined through flame photometry and expressed in kg ha^{-1}.

3.9.1.8 Nitrogen Uptake (kg ha^{-1})

Nitrogen uptake in plant sample was calculated by first taking 0.1 gm plant sample after oven drying for two days at 70^0 C and then the sample was allowed for digestion by adding 3 ml of conc Sulphuric Acid.

After digestion of sample, it was subjected to distillation and titration was done with 0.02 N H_2SO_4 and nitrogen uptake was calculated from the titre value.

$$\text{Nitrogen Uptake (kg ha}^{-1}\text{)} = \frac{\text{Nitrogen content (\%) x Weight of drymatter (kg ha}^{-1}\text{)}}{100}$$

$$\text{Nitrogen Uptake in Kernel (kg ha}^{-1}\text{)} = \frac{\text{Nitrogen content (\%) x Kernel yield (kg ha}^{-1}\text{)}}{100}$$

3.9.1.9 Protein Content (%)

Protein content in kernel was calculated by multiplying the estimated nitrogen percent by the factor 6.25 (Raghuramulu *et al.,* 1983).

3.9.1.10 Oil content (%) and Oil yield (kg ha^{-1})

The oil content in the kernel was determined using Soxhlet's apparatus using petroleum ether (60-80^0C) as an extractant. Oil yield was worked out with the following formula.

$$\text{Oil yield (kg ha}^{-1}\text{)} = \frac{\text{Oil content (\%) x kernel yield (kg ha}^{-1}\text{)}}{100}$$

3.10 ECONOMICS

The economics of different treatments were calculated by considering the input costs and output prices prevailing at the time of the harvest.

The net returns was calculated by deducting the cost of cultivation from the gross returns.

Net returns (Rs ha^{-1}) = Gross returns (Rs ha^{-1}) – Cost of cultivation (Rs ha^{-1})

The B: C Ratio was calculated as follows-

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

3.11 STATISTICAL ANALYSIS

All the data recorded in the study were subjected to statistical analysis using Fisher's method of analysis of variance as outlined by Panse and Sukhatme (1978) for the design adopted in this study. Statistical significance was tested by applying F-test at 0.05 level of probability. Critical differences at 0.05 levels were worked out for the effects, which were significant. The results are presented in various tables and depicted graphically wherever necessary.

Chapter – IV

RESULTS AND DISCUSSION

The results and discussions of the field experiment entitled "**Potential performance of groundnut (*Arachis hypogaea* L.) cultivars to levels of nitrogen"**, conducted during *rabi* 2020 on sandy loam soils at Agricultural College Farm, Bapatla are presented in this chapter.

4.1 WEATHER CONDITIONS DURING CROP GROWTH PERIOD

The growth and development of any crop normally is governed by weather parameters, such as temperature, relative humidity and rainfall during the crop growth period and depicted in fig. 3.1 and 3.2.

During the crop growth period, the weekly mean maximum temperatures ranged from 25.3^{o}C to 34.7 ^{o}C with an average of 31.2 ^{o}C, while the minimum temperatures ranged from 15.4^{o}C to 23.1^{o}C with an average of 19.5 ^{o}C. Similarly, the weekly mean relative humidity ranged from 48.0 to 96.1 %. A total rainfall of 23 mm was received during the crop growth period in a single rainy day.

The soil of the experimental site was sandy loam in texture, slightly acidic in pH, non-saline in nature, low in available organic carbon and nitrogen, medium in available P_2O_5 and K_2O.

Thus, the prevailing weather conditions being congenial for the growth and development of the groundnut crop did not display any adverse effect on their potential performance.

4.2 EFFECT OF VARIETIES AND NITROGEN LEVELS ON GROWTH PARAMETERS OF GROUNDNUT

4.2.1 Initial and Final Plant Population (m^2)

Perusal of data presented in table 4.1 revealed that initial and final plant population was not influenced significantly either by varieties or nitrogen levels due to non significant nature and similarly their interaction was found non – significant.

Table 4.1. Initial and final plant population (m^2) of groundnut as influenced by varieties and nitrogen levels

Treatments	Initial population	Final population
Varieties (V)		
V_1- Dharani	42	40
V_2-KadiriLepakshi	43	41
V_3 -TAG- 24	41	39
SEm±	1.84	1.25
CD (P=0.05)	NS	NS
Nitrogen levels (N)		
N_1- 0 kg N ha^{-1}	40	38
N_2 - 25 kg N ha^{-1}	41	39
N_3- 50 kg N ha^{-1}	43	41
N_4-75 kg N ha^{-1}	42	40
SEm±	2.12	1.45
CD (P=0.05)	NS	NS
Interaction (Vx N)		
SEm±	0.67	0.72
CD (P=0.05)	NS	NS
CV (%)	1.9	2.0

4.2.2 Plant Height (cm)

The data on mean plant height (cm) of different groundnut varieties recorded at 30,60,90 DAS and at harvest as influenced by nitrogen levels is presented in table 4.2.and fig. 4.1.

In general the plant height increased with the advance in age of crop upto 90 days and there after the increase was marginal. Interaction between varieties and 'N' levels for plant height was found non- significant at all the stages of crop growth.

Plant height differed significantly due to varieties and levels of nitrogen at 30, 60, 90 DAS and at harvest. Among the varieties significantly taller plants were recorded with dharani (14.9 cm) at 30 DAS and was found superior to kadiri lepakshi and TAG-24. The lowest plant height was recorded with TAG-24 at 30DAS. This might be due to the fact that plant height is normally depicted by the genetic makeup of plant as well as its surrounding environment.

At 60 DAS the highest plant height was registered with dharani (23.3 cm) which was on par with TAG-24 (20.3cm). The lowest plant height was associated with kadiri lepakshi.

At 90 DAS and at harvest the highest plant height was recorded with dharani (31.3 cm) which was superior to kadiri lepakshi (V_2) and TAG – 24(V_3). However, kadiri lepakshi (V_2) and TAG – 24 (V_3) cultivars exhibit comparable performance with each other.

At all the stages of observation the plant height increased significantly with the application of nitrogen up to 75 kg N ha^{-1}. The lowest plant height was associated with the treatment received (0 kg N ha^{-1}).

At 30 DAS, application of 75 kg N ha^{-1} recorded the highest plant height (13.8 cm), which was however on par with treatment receiving 25 kg N ha^{-1} and 50 kg N ha^{-1} (11.6 cm) (12.9 cm).

At 60 DAS, the highest plant height of (27.2 cm) was recorded with application of 75 kg Nha^{-1}while the treatment N_2(25 kg N ha^{-1}) was on par with N_3(50 kg N ha^{-1}). The lowest plant height was registered with the treatment N_1(0 kg N ha^{-1}).

At 90 DAS and at harvest the treatmental behaviour exhibited more or less a similar trend as that of 60 DAS with 75 kg N ha^{-1} (N_4), which was however statistically similar to 25 kg N ha^{-1} (N_2) and 50 kg N ha^{-1} (N_3). The lowest plant height was registered under control.

At all the stages of observation, plant height was found to increase with increase in levels of N application up to 75 kg N ha^{-1}. The higher levels of nitrogen assimilation might have accelerated the synthesis of higher chlorophyll and amino acids thus stimulating the cellular activity, responsible for cell division and meristematic growth. Similar results have been reported by Subrahmaniyan *et al.* (2006), Karunakaran *et al.* (2010), Ali and Seyyed (2010) and Chaudhary *et al.* (2015).

Table 4.2. Plant height (cm) of groundnut at different growth stages as influenced by varieties and nitrogen levels

Treatments	Plant height (cm)			
	30 DAS	**60 DAS**	**90 DAS**	**At harvest**
Varieties (V)				
V_1 - Dharani	14.9	23.3	31.3	32.9
V_2 - KadiriLepakshi	11.1	19.1	24.6	25.9
V_3 -TAG- 24	10.6	20.3	24.8	26.5
SEm±	0.66	1.13	1.47	1.26
CD (P=0.05)	2.0	3.3	4.3	3.7
Nitrogen levels (N)				
N_1 - 0 kg N ha^{-1}	10.6	14.7	19.1	24.7
N_2 -25 kg N ha^{-1}	11.6	19.3	26.4	26.7
N_3 - 50 kg N ha^{-1}	12.9	22.3	30.5	30.6
N_4 -75 kg N ha^{-1}	13.8	27.2	31.6	31.7
SEm±	0.77	1.31	1.70	1.45
CD (P=0.05)	2.3	3.8	5.0	4.3
Interaction (V x N)				
SEm±	1.33	2.26	2.94	2.51
CD (P=0.05)	NS	NS	NS	NS
CV (%)	6.3	6.2	6.3	5.1

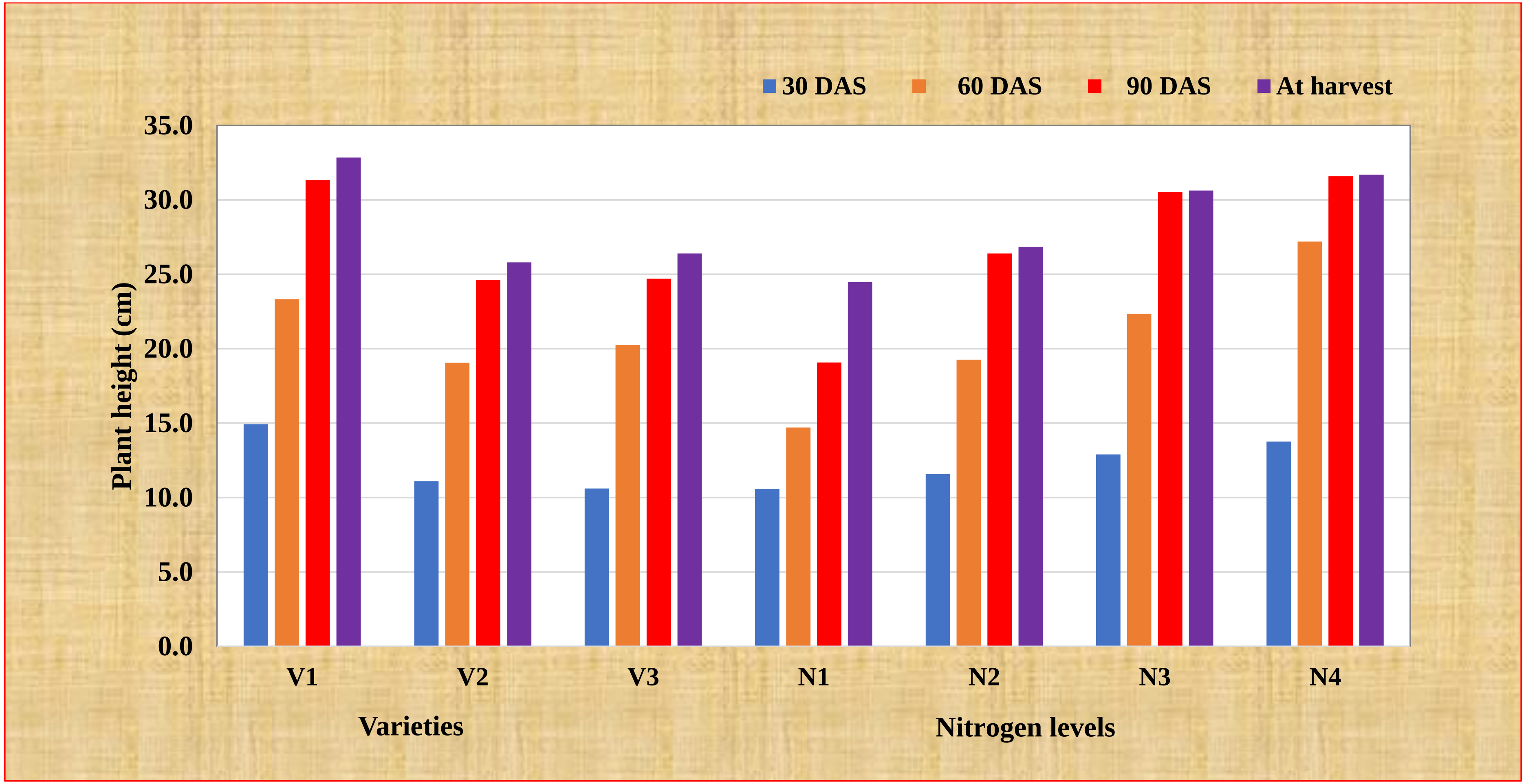

Fig. 4.1. Plant height (cm) of groundnut at different growth stages as influenced by varieties and nitrogen levels.

4.2.3 Number of Branches Plant^{-1}

The data pertaining to number of branches per plant^{-1} of different groundnut varieties recorded at various stages of crop growth as influenced by 'N' levels is presented in table 4.3 and fig. 4.2.

At 30 DAS the number of branches plant^{-1} did not differ with respect to varieties as well as nitrogen levels.

More number of branches plant^{-1} was recorded with kadiri lepakshi (6.4) at 60 DAS, which was statistically on par with TAG -24 (5.7). The lowest number of branches plant^{-1} was observed with variety dharani.

At 90 DAS and at harvest the highest number of branches plant^{-1} was associated with kadiri lepakshi (V_2) while the lowest number of branches plant^{-1} was recorded with dharani (V_1), which was however on par with TAG-24 (V_3). Identical behaviour of varieties in respect of number of branches was also reported by Mouri *et al.* (2018), Raagavalli *et al*. (2019) and Vijayakumar *et al*. (2019).

At 60DAS, 90 DAS and at harvest increased number of branches plant^{-1} was observed with 75 kg N ha^{-1}(6.3, 7.1 and 7.2) respectively which was at par with the treatment received 50 kg N ha^{-1} and 25 kg N ha^{-1} and the lowest number of branches was associated with no nitrogen application. Earlier Gogoi *et al.* (2000) and Bairagi *et al.* (2017) also reported similar results.

Table 4.3. Number of branches plant^{-1} of groundnut at different growth stages as influenced by varieties and nitrogen levels

Treatments	Number of branches plant^{-1}			
	30 DAS	60 DAS	90 DAS	At harvest
Varieties (V)				
V_1- Dharani	5.0	5.4	5.6	5.8
V_2-KadiriLepakshi	5.2	6.4	7.5	7.6
V_3- TAG- 24	4.9	5.7	5.8	6.0
SEm±	0.29	0.26	0.28	0.21
CD (P=0.05)	NS	0.8	0.8	0.6
Nirogen levels (N)				
N_1- 0 kg N ha^{-1}	4.6	5.3	5.7	5.9
N_2- 25 kg N ha^{-1}	5.1	5.6	6.1	6.3
N_3- 50 kg N ha^{-1}	5.2	6.1	6.3	6.6
N_4- 75 kg N ha^{-1}	5.4	6.3	7.1	7.2
SEm±	0.34	0.30	0.32	0.25
CD (P=0.05)	NS	0.9	1.0	0.7
Interaction (V x N)				
SEm±	0.58	0.51	0.60	0.43
CD (P=0.05)	NS	NS	NS	NS
CV (%)	6.6	5.1	5.2	5.2

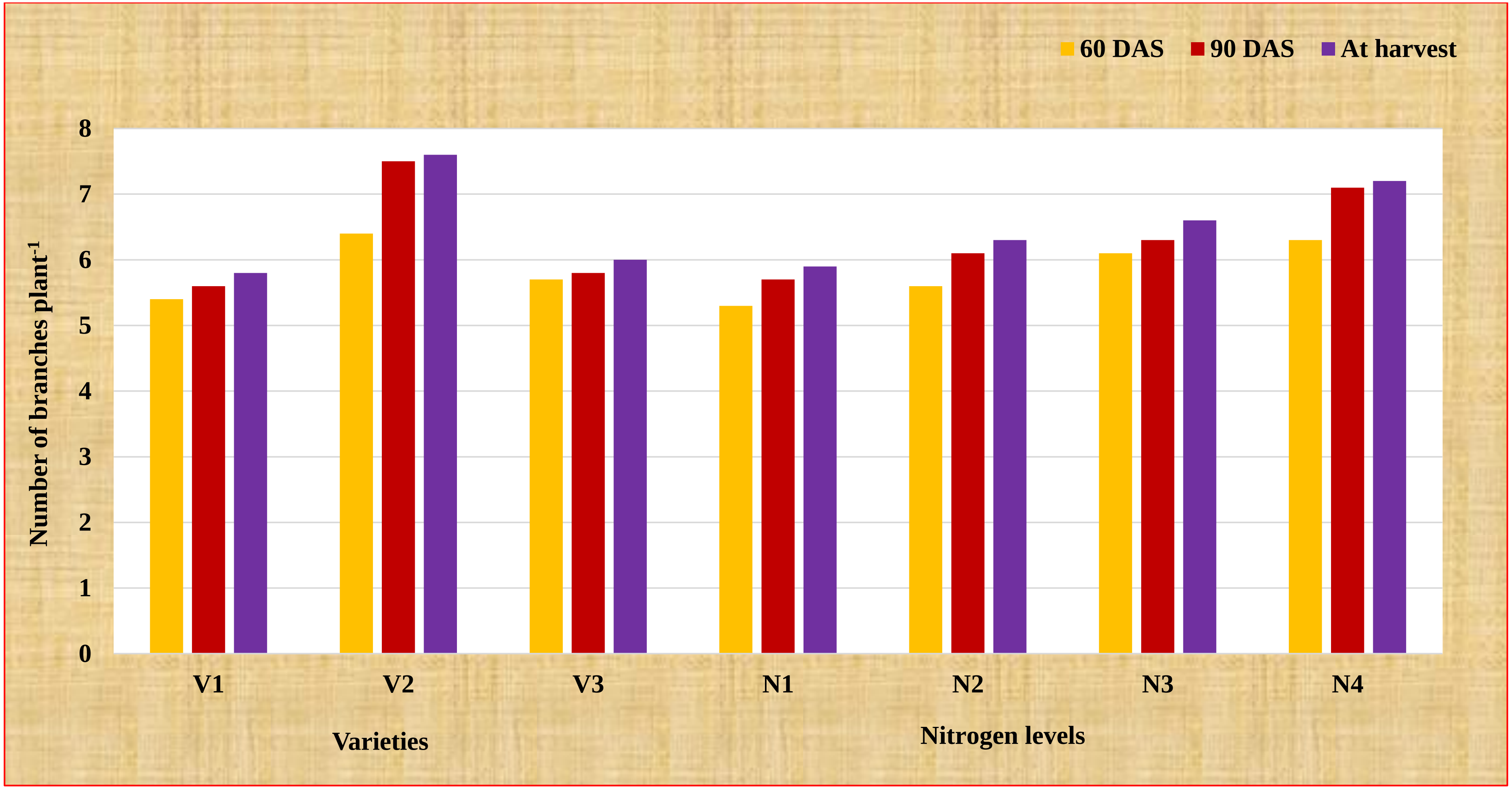

Fig 4.2. Number of branches plant^{-1} of groundnut at different growth stages as influenced by varieties and nitrogen levels.

4.2.4 Drymatter Accumulation (kg ha^{-1})

The data on drymatter accumulation (kg ha^{-1}) as influenced by varieties and levels of nitrogen is presented in table 4.4. and depicted in fig. 4.3. Drymatter accumulation differed significantly at all the stages of crop growth. Among the varieties drymatter accumulation was highest with kadiri lepakshi at 30, 60, 90 DAS and at harvest which however displayed statistically comparable behaviour with dharani (V_1) while the lowest drymatter accumulation was registered with TAG-24 (V_3). Interaction effect between varieties and nitrogen levels was found to be non-significant. It was observed that drymatter accumulation manifested a linear increase with the age of the crop and the maximum drymatter production observed at the time of harvest in all the three varieties tried and as it projected in this study was agreeing with the results of Talwar *et al.* (2002) and Patil *et al.* (2014).

The maximum drymatter accumulation recorded with the treatment received 75kg N ha^{-1} (2019.3 kg ha^{-1}) at 30,60 DAS and at harvest, was however found on par with the treatment received 50 kg N ha^{-1}(N_3). The minimum drymatter accumulation was associated with the treatment received no nitrogen. At 90 DAS drymatter accumulation was maximum with the treatment received 75 kg N ha^{-1}(9657.6 kg ha^{-1}) followed by 25 kg N ha^{-1} which displayed comparable performance with the treatment 50 kg N ha^{-1} (N_3). The lowest drymatter accumulation was observed with treatment that received no nitrogen.

Application of 75 kg N ha^{-1} was instrumental in recording higher drymatter accumulation (9857.6 kg ha^{-1}) at harvest and it was found on par with 50 kg N ha^{-1} (N_3). The lowest drymatter accumulation was recorded with no nitrogen application.

At all the stages of crop growth, incremental increase in the nitrogen levels from 0 kg N ha^{-1} to 75 kg N ha^{-1}consequently resulted in realising higher drymatter production. The increase in the assimilatory surface area plant^{-1}

might have caused an increase in its biomass, which ultimately lead to reserve a large quantity of photo assimilates as projected in the present investigation. It is in accordance with the results reported by Singh *et al.* (2001), Elayaraja and Singaravel (2009), Karunakaran *et al.* (2010), and Sengupta *et al.* (2016). Leaves being the critical organs act as the main photosynthetic structures of plants which convert diversified available resources into biomass (Marschner, 2012). Therefore, localized ammonical nitrogen along with phosphorous supply not only increased leaf expansion but seems to have motivated enhanced photosynthetic rate, which greatly contributed to the production of shoot biomass. (Qinghua *et al*., 2014).

4.2.5 Days to 50 per cent Flowering

Number of days to reach 50 % flowering did not differ significantly either by varieties or nitrogen levels, and their interaction also manifested non-significant values as presented in table 4.5.

Among the different treatments, number of days to reach 50% flowering ranged from 30-32 days. Increase in application of nitrogen delayed flowering. Increase in nitrogen doses extended the vegetative period in peanuts causing delay in the days to 50 % flowering of the crop (Gohari and Nayaki, 2010).

4.2.6 Days to Maturity

Perusal of data presented in table 4.5 indicated that the number of days taken by groundnut to reach physiological maturity was significantly influenced by varieties but not by nitrogen levels. Interaction effect between them was found non – significant.

However days to attain physiological maturity was significantly influenced by varieties as duration was different. Then among the different varietal treatments, number of days to maturity ranged from 94 (TAG -24) to 111 days in case of kadiri lepakshi.

Table 4.4. Drymatter accumulation (kg ha^{-1}) of groundnut at different growth stages as influenced by varieties and nitrogen levels

Treatments	Drymatter accumulation (kg ha^{-1})			
	30 DAS	**60 DAS**	**90 DAS**	**At harvest**
Varieties (V)				
V_1- Dharani	1560.2	3303.8	7122.4	7156.2
V_2- KadiriLepakshi	1592.1	3335.4	7795.9	7895.9
V_3- TAG- 24	1221.9	2602.0	6028.5	6328.5
Sem±	95.78	223.5	332.1	646.6
CD (P=0.05)	280.8	655.7	974.0	1896.2
Nitrogen levels (N)				
N_1- 0 kg N ha^{-1}	921.4	1978.0	4341.3	5638.8
N_2- 25 kg N ha^{-1}	1152.3	2525.0	6075.6	6862.8
N_3- 50 kg N ha^{-1}	1739.2	3617.6	7854.6	8154.6
N_4- 75 kg N ha^{-1}	2019.3	4200.1	9657.6	9857.6
Sem±	110.6	258.1	383.5	746.6
CD (P=0.05)	324.3	757.1	1124.6	2189.5
Interaction (V x N)				
SEm±	191.56	447.1	664.2	1293.2
CD (P=0.05)	NS	NS	NS	NS
CV (%)	7.6	8.4	5.5	9.5

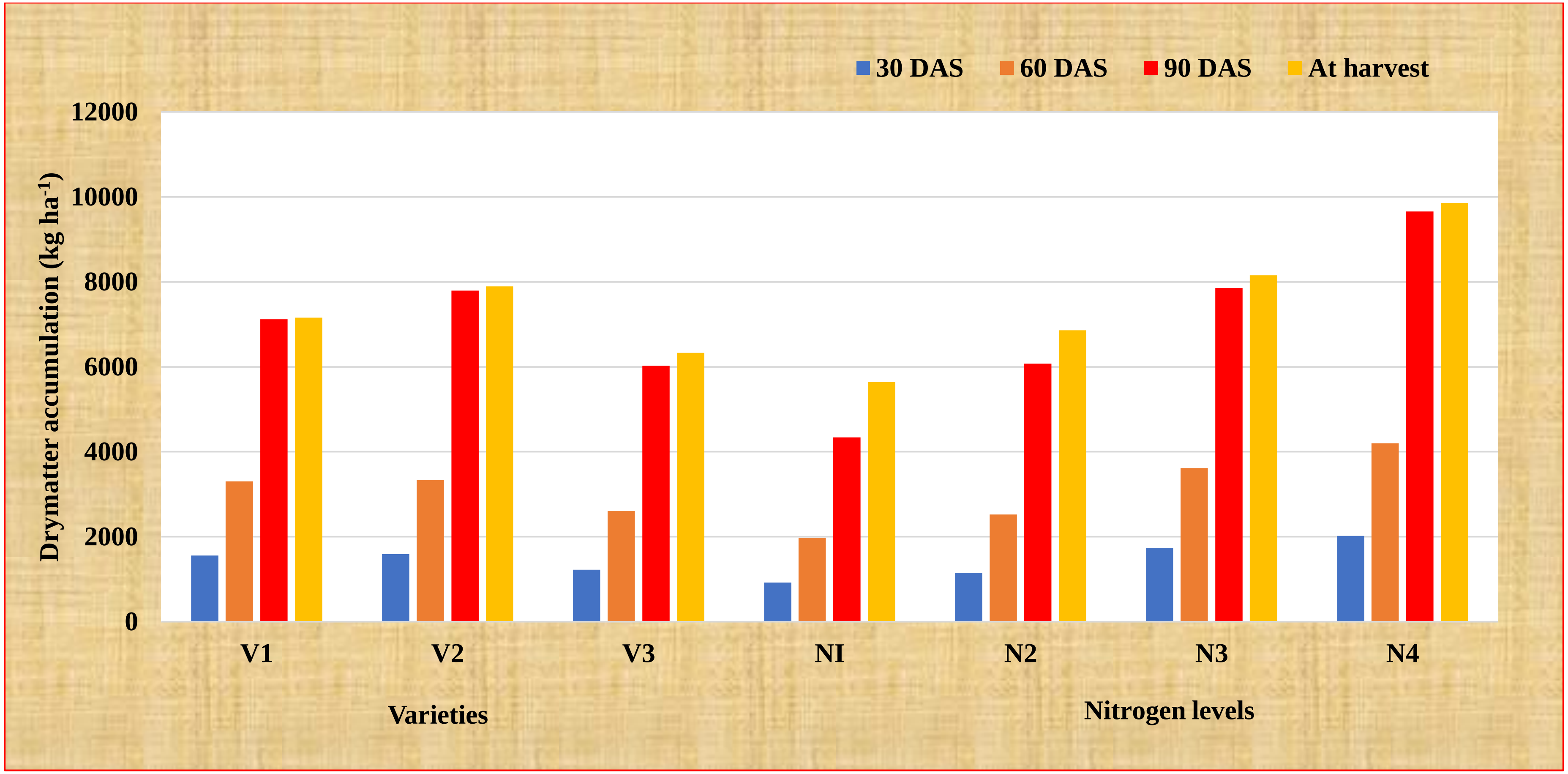

Fig. 4.3. Drymatter accumulation (kg ha^{-1}) of groundnut at different growth stages as influenced by varieties and nitrogen levels.

Table 4.5. Days to 50 per cent flowering and days to maturity of groundnut as influenced by varieties and nitrogen levels

Treatments	Days to 50 % flowering	Days to maturity
Varieties (V)		
V_1- Dharani	32	100
V_2- KadiriLepakshi	30	111
V_3- TAG- 24	31	94
SEm±	0.63	1.43
CD (P=0.05)	NS	4.0
Nitrogen levels (N)		
N_1- 0 kg N ha^{-1}	30	100
N_2- 25 kg N ha^{-1}	32	103
N_3- 50 kg N ha^{-1}	31	102
N_4- 75 kg N ha^{-1}	30	103
SEm±	0.73	1.65
CD (P=0.05)	NS	NS
Interaction (V x N)		
SEm±	1.33	2.85
CD (P=0.05)	NS	NS
CV (%)	2.4	1.6

4.2.7 Nodule Dry Weight (g plant^{-1})

The data on nodule dry weight is depicted in table 4.6. Nodule dry weight did not differ significantly with varieties but was influenced significantly by nitrogen levels. Nodule dry weight was noticed to be distinctly higher with the treatment receiving 75 kg N ha^{-1} (1.116 g plant^{-1}) compared to 0 kg N ha^{-1} but was on par with the supply of 50 kg N ha^{-1}. The lowest nodule dry weight was recorded under no nitrogen treatment (N_1).

Application of nitrogenous fertilizers might have stimulated microbe flush and improved root growth and better source- sink relationship lead to better nodulation. Due to congenial soil physical condition created by nitrogen might have enhanced the cell division in the process of nodule formation and development. Similar results were documented by Kausale *et al*. (2009), Sharma *et al*. (2011) and Bagal *et al*. (2012).

4.3 EFFECT OF VARIETIES AND NITROGEN LEVELS ON YIELD ATTRIBUTES OF GROUNDNUT

4.3.1 Number of Pods Plant^{-1}

The data on number of pods plant^{-1} presented in table 4.7 and fig. 4.4 indicated significant differences due to varieties and levels of nitrogen. However their interaction effect was observed to be non- significant.

Number of pods plant^{-1} was significantly influenced by varieties since it is governed by varietal characteristics. The highest number of pods plant^{-1} recorded with kadiri lepakshi (28.9) and exhibited significant superiority over dharani (V_1) and TAG-24 (V_3). The lowest number of pods plant^{-1} observed with TAG- 24 (V_3) was found on par with dharani(V_1). Identical features of varieties as exhibited by dharani and TAG-24 were also reported by Ramesh and Sambasiva Reddy (2007), Mouri *et al.* (2018) and Shendage *et al*. (2018).

Table 4.6. Nodule dry weight (g plant^{-1}) of groundnut as influenced by varieties and nitrogen levels at 60DAS.

Treatments	Nodule Dry Weight (g plant^{-1}) at 60DAS
Varieties (V)	
V_1- Dharani	0.835
V_2-KadiriLepakshi	1.096
V_3- TAG- 24	0.927
SEm±	0.103
CD (P=0.05)	NS
Nitrogen levels (N)	
N_1- 0 kg N ha^{-1}	0.616
N_2- 25 kg N ha^{-1}	0.983
N_3- 50 kg N ha^{-1}	1.096
N_4- 75 kg N ha^{-1}	1.116
SEm±	0.119
CD (P=0.05)	0.348
Interaction(V x N)	
SEm±	0.206
CD (P=0.05)	NS
CV (%)	12.8

Application of 75 kg N ha^{-1} to groundnut exhibited superior performance over other nitrogen levels. However it was comparable with the treatment receiving 50 kg N ha^{-1} (N_3) and 25 kg N ha^{-1} (N_2). The minimum numbers of pods plant^{-1} were observed in the control plot (0 kg N ha^{-1}).

Elevated levels of nitrogen manifested adequate availability of nutrients to growing plant thus presenting greater utilization of assimilates to transform into pods which in turn increased number of pods plant^{-1}. These results are in accordance to the findings of Chaudhary *et al.* (2015), Paul *et al*. (2016), Sagvekar *et al*. (2017), Waghmode *et al*. (2017) and Yenagi *et al.* (2017).

4.3.2 Number of Filled Pods Plant^{-1}

The data on number of filled pods plant^{-1} is presented in table 4.7 and fig. 4.4 indicated significant differences due to varieties but displayed non - significant performance with levels of nitrogen. The interaction was also, observed to be non- significant.

Number of filled pods plant^{-1} also manifested significant behaviour due to varieties as it is a varietal characteristic. The highest number of filled pods plant^{-1} (15.0) was observed in the variety kadiri lepakshi which was distinctly superior to dharani and TAG-24. Dharani however, was statistically similar to TAG-24. The lowest number of filled pods was associated with the cultivar TAG- 24. The above results are in confirmation with those of Subrahmaniyam and Kalaiselvam, (2006) and Ramesh and Sambasiva Reddy (2007).

4.3.3 Number of Kernels Pod^{-1}

The data on number of kernels pod^{-1} is presented in table 4.7 and fig. 4.4. The number of kernels pod^{-1} did not differed significantly with varieties but exhibited significant differences with nitrogen levels. The interaction effect observed was however, non- significant. This clearly indicates that in groundnut the number of kernels pod^{-1} is principally monitored mostly by genetically controlled factors.

Table 4.7. Number of pods plant^{-1}, number of filled pods plant^{-1} and number of kernels pod^{-1} of groundnut as influenced by varieties and nitrogen levels.

Treatments	Number of pods plant^{-1}	Number of filled pods plant^{-1}	Number of kernels pod^{-1}
Varieties (V)			
V_1- Dharani	22.1	11.7	1.6
V_2- KadiriLepakshi	28.9	15.0	1.6
V_3- TAG – 24	17.5	9.9	1.5
SEm±	1.72	0.83	0.05
CD (P=0.05)	5.0	2.4	NS
Nitrogen levels (N)			
N_1- 0 kg N ha^{-1}	17.6	10.3	1.4
N_2- 25 kg N ha^{-1}	22.0	12.4	1.5
N_3- 50 kg N ha^{-1}	25.5	12.5	1.6
N_4- 75 kg N ha^{-1}	26.2	13.6	1.8
SEm±	1.92	0.96	0.09
CD (P=0.05)	5.8	NS	0.2
Interaction (V x N)			
SEm±	3.28	1.66	0.15
CD (P=0.05)	NS	NS	NS
CV (%)	8.7	7.9	5.6

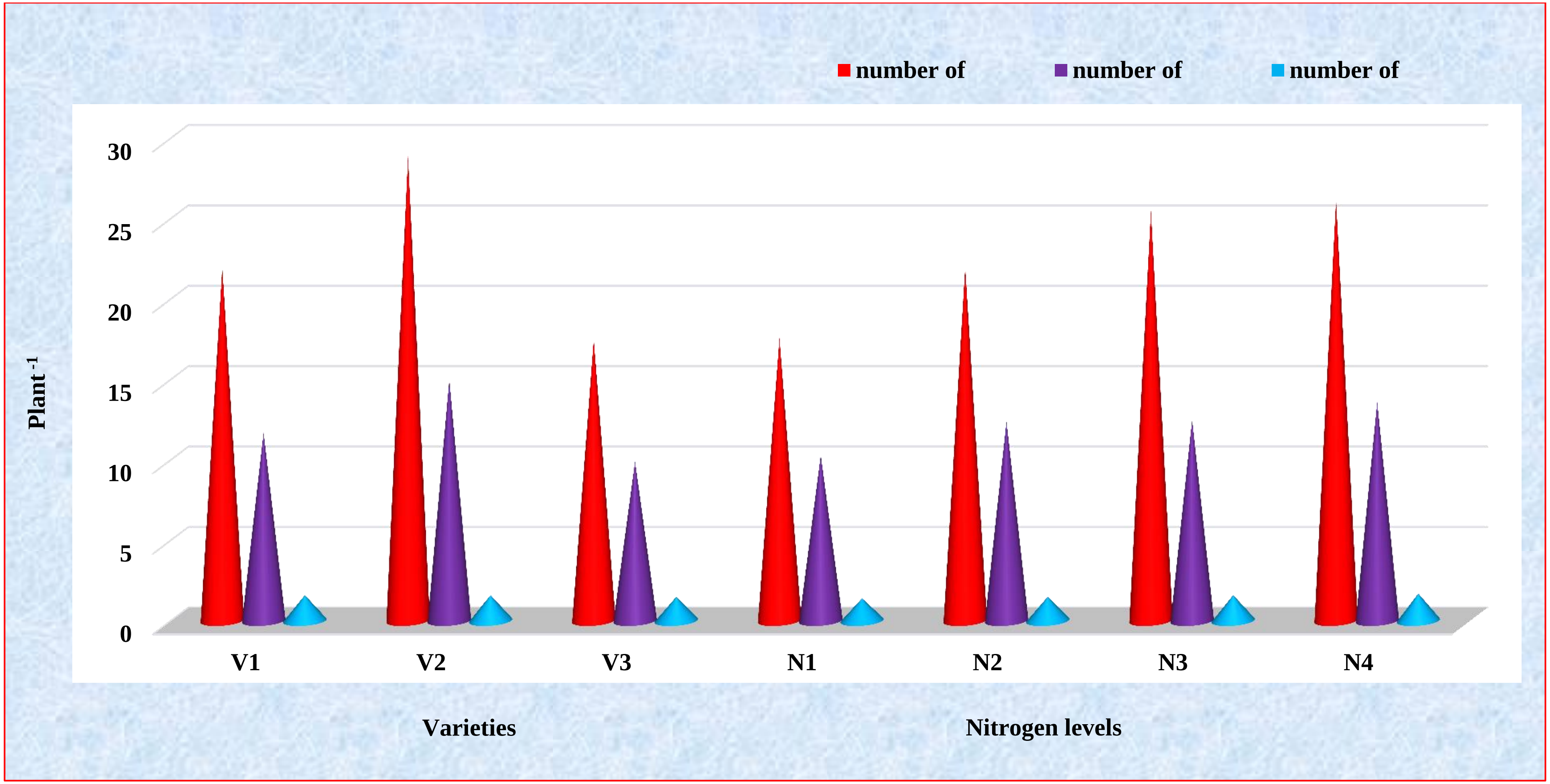

Fig. 4.4. Number of pods plant^{-1}, number of filled pods plant^{-1} and number of kernels pod^{-1} of groundnut as influenced by varieties and nitrogen levels.

4.3.4 100 Kernel Weight (g)

The data pertaining to 100 kernel weight is presented in table 4.8. Test weight of groundnut was significantly influenced by varieties but differed non-significantly with nitrogen levels. However the interaction between varieties and nitrogen levels was observed to be non significant.

The highest kernel weight was recorded with dharani (42 g) which displayed comparable performance with kadiri lepakshi (40 g). The lowest kernel weight was recorded with TAG-24 (V_3). This is in line with the results reported by Kathirvelan and Kalaiselvan (2006), Subrahmaniyam and Kalaiselvam, 2006, Banik, *et al*. (2009) and Mouri *et al.* (2018).

4.3.5 Shelling Percentage (%)

The data pertaining to shelling percentage is presented in table 4.8. Shelling percentage of groundnut was not influenced significantly by varieties and nitrogen levels as well as their interaction. Similar results were reported by Patil *et al*. (2014), Mouri *et al.* (2018) and Raagavalli *et al*. (2019).

4.4 EFFECT OF VARIETIES AND NITROGEN LEVELS ON YIELD OF GROUNDNUT

4.4.1 Pod Yield (kg ha^{-1})

An insight into the data pertaining to pod yield of groundnut presented in table 4.9 and fig. 4.5 indicated significant difference among the varieties and levels of nitrogen. However their interactions failed to produce significant differences in pod yield.

There was a significant difference in pod yield with respect to varieties. The maximum pod yield recorded with kadiri lepakshi (2979.6 kg ha^{-1}) was however, statistically comparable with dharani (2413 kg ha^{-1}). The minimum pod yield was registered with TAG-24.

Table 4.8. 100 Kernel weight (g) and Shelling percentage (%) of groundnut influenced by varieties and nitrogen levels

Treatments	100 Kernel Weight (g)	Shelling percentage (%)
Varieties (V)		
V_1- Dharani	42.0	75.6
V_2- KadiriLepakshi	40.0	71.8
V_3- TAG – 24	34.0	70.0
SEm±	1.10	2.87
CD (P=0.05)	3.1	NS
Nitrogen levels (N)		
N_1- 0 kg N ha^{-1}	37.2	69.2
N_2- 25 kg N ha^{-1}	37.9	72.0
N_3- 50 kg N ha^{-1}	39.3	73.4
N_4- 75 kg N ha^{-1}	40.2	75.2
SEm±	1.21	3.32
CD (P=0.05)	NS	NS
Interaction (V x N)		
SEm±	4.61	5.74
CD (P=0.05)	NS	NS
CV (%)	3.1	4.6

The highest pod yield was recorded with kadiri lepakshi may be attributed to its higher yield potential up to 4200 kg ha^{-1}. The highest kernel yield recorded with kadiri lepakshi (2218.0 kg ha^{-1}) was found on par with dharani (1875.4 kg ha^{-1}). Similar results were also reported by Kamara *et al*. (2011), Reddy *et al.* (2014) and Raagavalli *et al.* (2019).

Among the nitrogen levels the highest pod yield was associated with the treatment supplied with 75 kg N ha^{-1} (3075.6 kg ha^{-1}) which was however on par with application of 25 kg N ha^{-1} (N_2) and 50 kg N ha^{-1} (N_3) respectively. The lowest pod yield was obtained under the treatment which received no nitrogen. Application of 75 kg and 50 kg N ha^{-1} though did not differ significantly in pod yield but was significantly higher than 0 kg N ha^{-1} (Parameshwarareddy *et al,* 2019). Increase in pod yield with increase in nitrogen application as projected in the present study was also reported by Shivakumar *et al*. (2014), Gunri *et al.* (2015), Paul *et al*. (2016) and Sagavekar *et al.* (2017).

Increased level of nitrogen fertilization might have created a congenial rhizosphere towards the formation and better functional nodulation besides growth and development of vegetative as well as reproductive organs of groundnut. Further adequate nitrogen fertilization might have stimulated the rate of photosynthesis towards formation of photosynthetic matter, thereby increasing the yield components and finally the pod yield. In addition the localized application of urea and phosphorus might also aided in the proliferation of healthy root growth, which could contribute greatly to improved nutrient uptake and biomass accumulation. Greater nutrient uptake, further have resulted in producing higher number of filled pods, which together consequently manifested in higher pod yield of groundnut. Similar findings have been reported by Jadhav *et al*. (2000).

4.4.2 Haulm Yield (kg ha^{-1})

The data on haulm yield of groundnut is presented in table 4.9. Haulm yield exhibited significant differences both in respect of varieties and nitrogen levels while its interaction displayed negative result. Among the groundnut varieties tested kadiri lepakshi registered the maximum haulm yield (4921.7 kg ha^{-1}), which was on par with dharani (4502.8 kg ha^{-1}). The minimum haulm yield was associated with TAG – 24 (V_3). This morphological difference in the varieties might be due to both vegetative growth characteristics and over all biomass displayed by kadiri lepakshi, which reflected haulm yield. This can be attributed to the genetic makeup of the genotype besides the environmental conditions. The results revealed in the present study confirm with the findings of were reported by Jadhav *et al*. (2000), Ramesh and Sambasiva Reddy (2007) and Nirmal *et al.* (2015).

With regard to the nitrogen levels, application of 75 kg N ha^{-1}(N_4) registered the highest haulm yield (5070.6 kg ha^{-1}) which was statistically similar to the treatment supplied with 50 kg N ha^{-1} (4536.8 kg ha^{-1}) and 25 kg N ha^{-1} (4400.3 kg ha^{-1}) respectively. These two treatments (N_2 and N_3) which were comparable between them exhibited significantly superior performance over N_1 treatment. This might be due to enhanced drymatter accural reflecting in morphological characters like plant height and number of branches. Adequate N supply in the rhizosphere might have enhanced the root proliferation, besides increasing the multiplication of micro flora and fauna thus reflecting on the enhanced biomass accumulation, thereby increasing the haulm yield. These findings are supported by the statements of Jadhav *et al*. (2000) and Ramesh and Sambasiva Reddy (2007).

4.4.3 Harvest Index

The data pertaining to harvest index is presented in table 4.9. harvest index did not differ significantly with respect to either varieties or nitrogen levels. The interaction effect was also found non -significant. Similar results were reported by Mouri *et al.* (2018).

Table 4.9. Pod yield, haulm yield, kernel yield and harvest index of groundnut as influenced by varieties and nitrogen levels.

Treatments	Pod yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Kernel yield (kg ha^{-1})	Harvest index
Varieties (V)				
V_1- Dharani	2413.0	4502.8	1875.4	35.9
V_2- Kadiri Lepakshi	2979.6	4921.7	2218.0	37.5
V_3- TAG – 24	2187.8	4152.9	1541.1	32.7
SEm±	196.5	199.0	203.4	2.21
CD (P=0.05)	576.2	583.8	596.5	NS
Nitrogen levels (N)				
N_1- 0 kg N ha	1992.4	4095.6	1414.7	32.8
N_2- 25 kg N ha^{-1}	2492.9	4400.3	1859.0	35.8
N_3- 50 kg N ha^{-1}	2546.3	4536.8	1911.4	35.5
N_4- 75 kg N ha^{-1}	3075.6	5070.6	2327.7	37.4
SEm±	226.9	229.8	234.8	2.55
CD (P=0.05)	665.4	674.1	688.8	NS
Interaction (V x N)				
SEm±	392.9	398.1	406.8	4.42
CD (P=0.05)	NS	NS	NS	NS
CV (%)	9.0	9.9	12.5	7.2

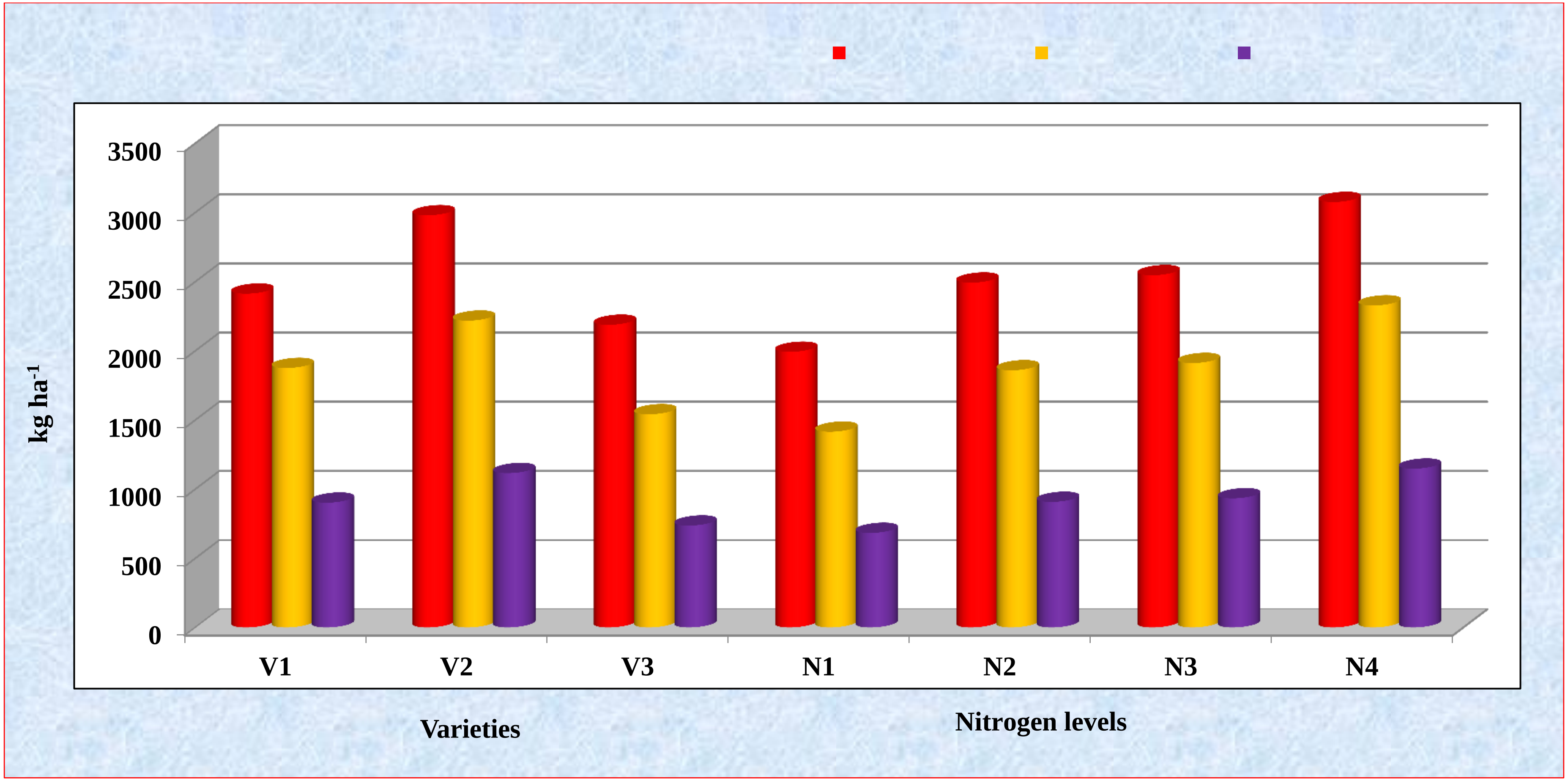

Fig. 4.5. Pod yield (kg ha^{-1}), kernel yield (kg ha^{-1}) and oil yield (kg ha^{-1}) of groundnut as influenced by varieties and nitrogen levels.

4.5.1 Nitrogen Content (%) and Nitrogen Uptake (kg ha^{-1})

Nitrogen content and uptake of (N) by groundnut estimated in haulm at flowering, pegging and in kernel at harvest was significantly influenced by different varieties and nutrient levels tried, while interaction effect was not statistically significant. The nitrogen content and uptake data are presented in table 4.10 and 4.11 and fig. 4.6 and 4.7 respectively.

Higher values of content and uptake of nitrogen was found with the variety kadiri lepakshi (V_2) over other two varieties. Nitrogen content was found non- significant with varieties at 30,60 DAS and at harvest in kernel. The highest nitrogen content recorded with kadiri lepakshi (V_2) at 90DAS in haulm was found on par with dharani (V_1). The lowest nitrogen content was recorded with TAG-24. Among the nitrogen levels, 75 kg N ha^{-1} observed with significantly the highest nitrogen content and it was found on par with 25 kg N ha^{-1} and 50 kg N ha^{-1}.

Nitrogen uptake of varieties is mostly governed based on the amount of drymatter produced besides the concentration of nutrients in various plant parts. The higher uptake of nitrogen recorded with kadiri lepakshi (V_2) and was comparable with TAG -24 (V_3). This might be due to the inherent characteristic feature of the kadiri lepakshi cultivar to absorb greater quantity of nutrients and the variation may also be due to the nitrogen content of different cultivars.

Higher uptake of nitrogen (N) observed with application of 75 kg N ha^{-1} (N_4), was on par with 50 kg N ha^{-1} at 30, 60DAS and at harvest in haulm and kernel. At 90 DAS higher nitrogen uptake recorded with application of 75 kg N ha^{-1} was found superior to other nitrogen levels tried. The nitrogen uptake in kernel with application of 75 kg N ha^{-1} at harvest was significantly the highest over control and it was found on par with 25 kg and 50 kg N ha^{-1}. This could be mainly due to the efficient absorption of large quantities of mineral nutrients coupled with higher drymatter production under high nutrient levels. The present investigation confirms the document evidence of Shivakumar *et al*. (2014).

Since nitrogen uptake is a function of yield and its concentrations in plants, thus significant uptake by the plant might have resulted in higher yields. Steady and adequate supply of nitrogen throughout the crop growth period could be the possible reason in increasing the nitrogen availability for higher uptake and progressive utilization by the crop, which in turn modified to produce incremental photosynthates for better partitioning of drymatter from source to sink. Localised placement of P and ammonium fertilizer might have modified the rhizosphere processes by stimulating root proliferation and by ammonium induced rhizosphere acidification, thereby increasing N acquisition by plants. These results are in conformity with the findings of El- Habbasha *et al.* (2013) and Chavan *et al.* (2014).

Table 4.10. Nitrogen content (%) of groundnut at different growth stages as influenced by varieties and nitrogen levels

Treatments	Days after sowing				
	30DAS	60DAS	90DAS	At harvest	
				Haulm	Kernel
Varieties (V)					
V_1- Dharani	1.81	2.09	1.63	1.03	3.79
V_2- KadiriLepakshi	2.07	2.20	1.88	0.97	3.81
V_3- TAG – 24	1.96	2.04	1.50	0.90	3.53
SEm±	0.10	0.14	0.10	0.08	0.10
CD (P=0.05)	NS	NS	0.29	0.25	NS
Nitrogen levels (N)					
N_1- 0 kg N ha^{-1}	1.69	1.71	1.46	0.83	3.47
N_2- 25 kg N ha^{-1}	1.86	2.07	1.65	0.79	3.72
N_3- 50 kg N ha^{-1}	2.04	2.17	1.75	1.10	3.74
N_4- 75 kg N ha^{-1}	2.19	2.22	1.82	1.15	3.91
SEm±	0.11	0.16	0.12	0.10	0.11
CD (P=0.05)	0.33	0.48	0.34	NS	0.32
Interaction (V x N)					
SEm±	0.20	0.28	0.20	0.17	0.29
CD (P=0.05)	NS	NS	NS	NS	NS
CV (%)	7.2	7.9	6.9	11.1	5.3

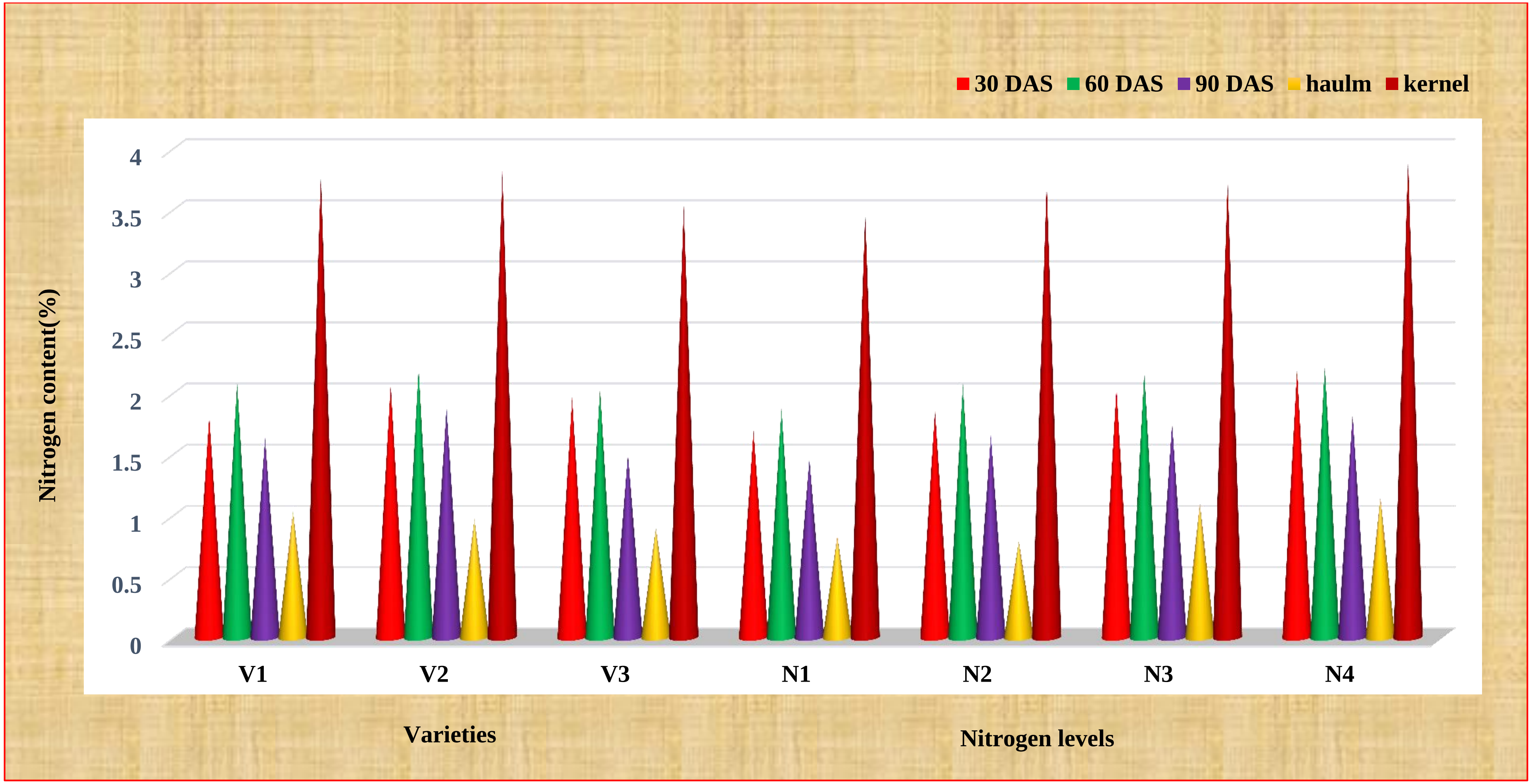

Fig. 4.6. Nitrogen content (%) of groundnut at different growth stages as influenced by varieties and nitrogen levels.

Table 4.11. Nitrogen uptake (kg ha^{-1}) of groundnut at different growth stages as influenced by varieties and nitrogen levels

Treatments	Days after sowing				
	30 DAS	60 DAS	90 DAS	At Harvest	
				Haulm	Kernel
Varieties (V)					
V_1- Dharani	21.7	68.5	121.8	73.7	71.0
V_2- KadiriLepakshi	23.4	71.0	145.9	76.5	85.9
V_3- TAG- 24	17.2	55.6	92.4	56.9	55.0
SEm±	2.1	6.4	8.7	12.4	8.4
CD (P=0.05)	NS	NS	25.7	36.4	24.6
Nirogen levels (N)					
N_1- 0 kg N ha^{-1}	14.5	37.2	63.5	46.8	53.2
N_2- 25 kg N ha^{-1}	19.4	52.5	103.9	54.2	65.9
N_3- 50 kg N ha^{-1}	21.7	78.5	138.9	89.7	72.5
N_4- 75 kg N ha^{-1}	27.5	92.3	173.9	113.3	90.9
SEm±	2.4	7.4	10.1	14.3	9.7
CD (P=0.05)	7.1	21.9	29.7	42.0	28.4
Interaction (V x N)					
SEm±	4.2	12.9	17.5	24.8	16.8
CD (P=0.05)	NS	NS	NS	NS	NS
CV (%)	11.7	11.4	8.4	16.1	13.7

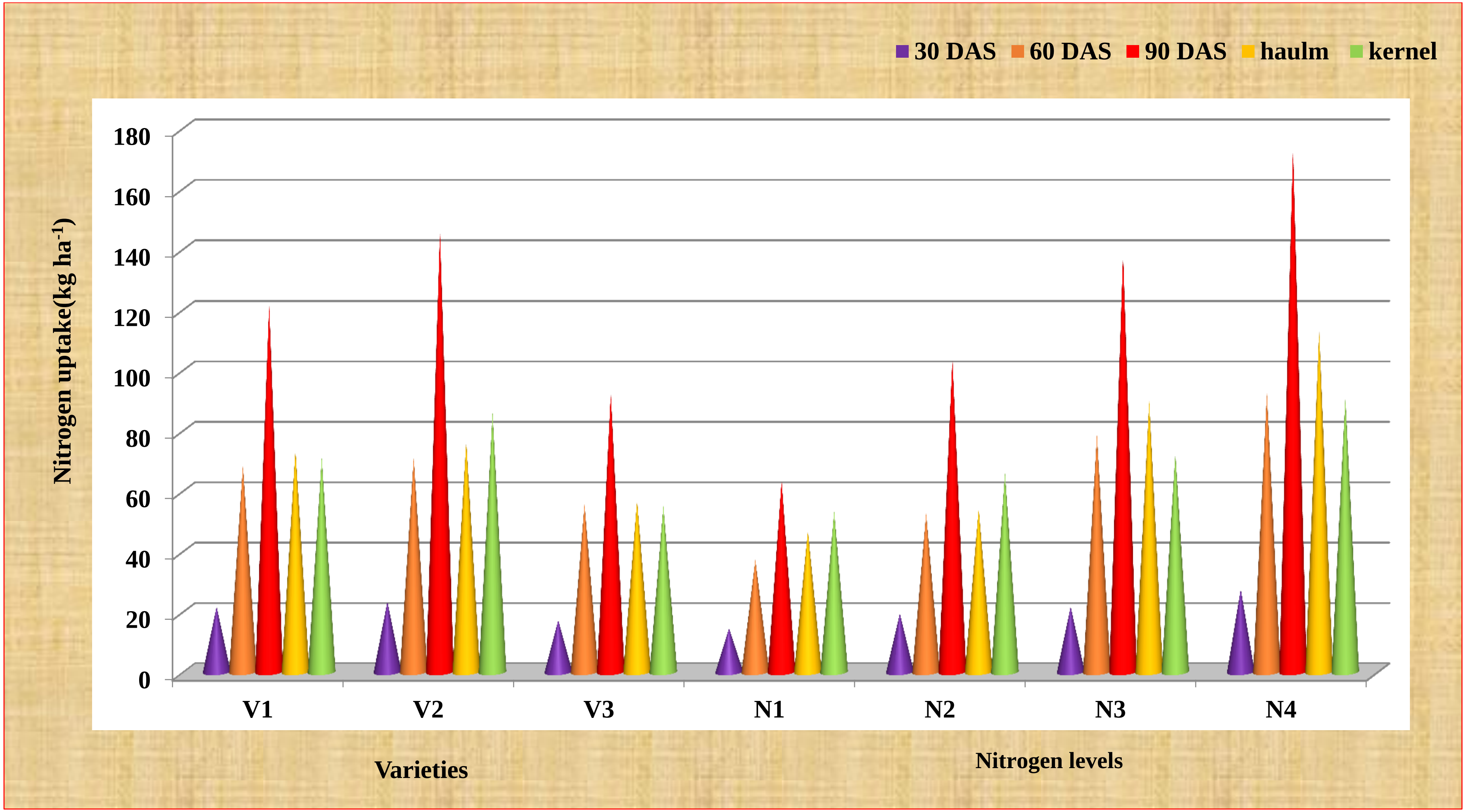

Fig. 4.7. Nitrogen uptake (kg ha^{-1}) of groundnut at different growth stages as influenced by varieties and nitrogen levels.

4.5 QUALITY PARAMETERS

The data on effect of varieties and nitrogen levels on oil content, oil yield and protein content are presented in table 4.12. From data it is observed that oil content and oil yield ranged from 47.7 to 50.0 % and 736.5 to 1115.6 kg ha^{-1} respectively, in groundnut kernel.

4.5.1 Oil Content (%)

The data on oil content is presented in table 4.12 and fig. 4.8. Among the varieties the highest oil content was recorded with kadiri lepakshi (50.0 %) which was on par with dharani (48.1%) and the lowest oil content was recorded with TAG-24 (V_3). The oil content differed significantly with varieties due to more assimilation of nutrients by varieties.

Oil content did not differ significantly with nitrogen levels as it is varietal characteristic and depends on variety. Similar findings were reported by Patil *et al.* (2014).

4.5.2 Oil Yield (kg ha^{-1})

The data on oil yield is presented in table 4.12 and fig. 4.5. Among the varieties the highest oil yield was recorded with kadiri lepakshi (1115.6 kg ha^{-1}) which was on par with dharani (901.9 kg ha^{-1}) and the lowest oil yield was recorded with TAG-24 (V_3).

Oil yield did not differ significantly with nitrogen levels and interaction effect between them was also found non- significant.

4.5.3 Protein Content (%)

The data pertaining to protein content is presented in table 4.12 and fig. 4.8. protein content did not differ significantly with varieties but differed significantly with nitrogen levels. The interaction effect between varieties and nitrogen levels on protein content was found non- significant.

The protein content of groundnut ranged from (15- 23 %) with respect to varieties.

Among the nitrogen levels the highest protein content recorded with 75 kg N ha^{-1} (25.7%) was found on par with the treatment receiving 25 kg and 50 kg N ha^{-1}. The lowest protein content was recorded with control (N_1). This might be due to improved physiological and biochemical activity of groundnut under comfortable availability of nitrogen, which lead to more nitrogen uptake and thus resulting in higher values of protein content. Similar findings were also reported by Patil *et al.* (2014).

Table 4.12. Oil content (%), oil yield (kg ha^{-1}) and protein content (%) of groundnut as influenced by varieties and nitrogen levels

Treatments	Oil content (%)	Oil yield (kg ha^{-1})	Protein content (%)
Varieties (V)			
V_1- Dharani	48.1	901.9	23.7
V_2-KadiriLepakshi	50.0	1115.6	23.8
V_3- TAG – 24	47.7	736.5	22.1
SEm±	0.55	97.7	0.60
CD (P=0.05)	1.6	287.3	NS
Nitrogen levels (N)			
N_1- 0 kg N ha^{-1}	48.0	683.4	23.4
N_2- 25 kg N ha^{-1}	48.5	907.6	21.7
N_3- 50 kg N ha^{-1}	48.9	933.1	23.2
N_4- 75 kg N ha^{-1}	49.0	1147.8	24.4
SEm±	1.23	113.1	0.69
CD (P=0.05)	NS	NS	NS
Interaction (V x N)			
SEm±	1.09	195.9	1.20
CD (P=0.05)	NS	NS	NS
CV (%)	1.3	12.3	5.2

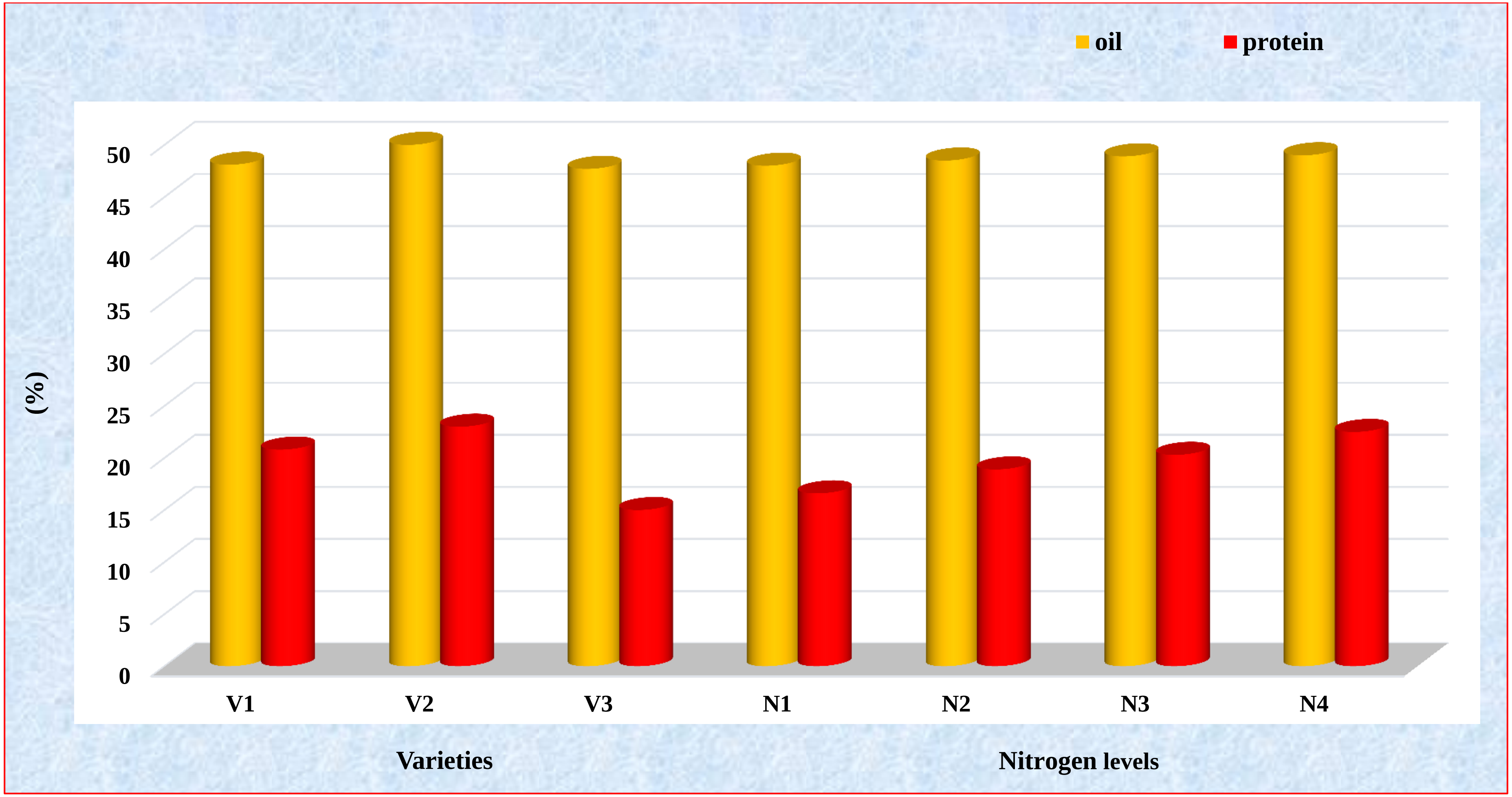

Fig. 4.8. Oil content (%) and protein content (%) of groundnut as influenced by varieties and nitrogen levels.

4.6 POST – HARVEST SOIL FERTILITY STATUS

The data pertaining to soil pH, E.C and organic carbon after harvest were presented in table 4.13. The results revealed that soil pH, E.C and organic carbon were not influenced by either varieties or nitrogen levels at any stage of the crop and their interactions was found non-significant.

Perusal of data depicted in table 4.14. indicated that the available nitrogen in soil after harvest of groundnut was significantly influenced by varieties and nitrogen levels. Varieties and levels of nitrogen failed to produce significant effect on soil available phosphorus and potassium. Interaction effect between varieties and nitrogen levels did not produce any significant result.

The post – harvest soil available nutrient status (N, P and K) observed with variety kadiri lepakshi (V_2) was found higher in available nutrients in soil followed by dharani (V_1). TAG- 24 (V_3) registered the lowest soil available nutrients.

The nutrients retained in the soil after harvest of the crop mainly depends on both supply of nutrients through various sources and uptake by the crop. Split application and ammonium form of nitrogen might have reduced loss of nutrients, in terms of leaching, volatilization as well as denitrification as a result increasing available nitrogen content. Acidification of soil might have resulted in further availability of phosphorus in soil. Further, higher the nutrients quantity supplied higher is the residual soil nutrients. So, control plot resulted in lower available nutrients and 75 kg N ha^{-1} plots with higher available nutrients. These results are in conformity with the findings of Karunakaran *et al.* (2010) and Sengupta *et al.* (2016).

Table 4.13. pH, E.C(dS m^{-1}) and Organic carbon (%) in soil after harvest of groundnut as influenced by varieties and nitrogen levels

Treatments	pH	E.C (dS m^{-1})	Organic Carbon (%)
Varieties (V)			
V_1- Dharani	6.7	0.4	0.3
V_2-KadiriLepakshi	6.7	0.7	0.3
V_3- TAG-24	6.7	0.5	0.4
SEm±	0.16	0.09	0.01
CD (P=0.05)	NS	NS	NS
Nitrogen levels (N)			
N_1- 0 kg N ha^{-1}	6.7	0.4	0.3
N_2- 25 kg N ha^{-1}	6.6	0.4	0.3
N_3-50 kg N ha^{-1}	6.7	0.5	0.3
N_4-75 kg N ha^{-1}	6.7	0.7	0.4
SEm±	0.18	0.10	0.02
CD (P=0.05)	NS	NS	NS
Interaction (V x N)			
SEm±	0.32	0.18	0.03
CD (P=0.05)	NS	NS	NS
CV (%)	2.7	19.7	4.7

Table 4.14. Available nitrogen, phosphorus and potassium (kg ha^{-1}) in soil after harvest of groundnut as influenced by varieties and nitrogen levels

Treatments	N	P_2O_5	K_2O
Varieties (V)			
V_1- Dharani	182.0	30.2	220.3
V_2-Kadiri Lepakshi	213.0	27.2	195.6
V_3- TAG-24	178.7	28.9	236.5
SEm±	9.97	1.57	12.52
CD (P=0.05)	29.2	NS	NS
Nitrogen levels (N)			
N_1- 0 kg N ha^{-1}	147.4	37.3	233.3
N_2- 25 kg N ha^{-1}	167.7	31.5	230.0
N_3- 50 kg N ha^{-1}	206.8	25.9	214.0
N_4-75 kg N ha^{-1}	243	20.2	191.9
SEm±	11.51	1.82	14.45
CD (P=0.05)	33.7	NS	NS
Interaction (V x N)			
SEm±	19.94	3.15	25.03
CD (P=0.05)	NS	NS	NS
CV (%)	6.0	6.3	6.7

4.7 ECONOMICS

Economics of groundnut crop as influenced by varieties and nitrogen levels are worked out and presented in table 4.15 and fig. 4.9.

4.7.1 Gross Returns (Rs. ha^{-1})

Gross returns of groundnut were significantly influenced by different varieties and nutrient levels, while interaction was found to be non – significant.

The highest gross returns realised with kadiri lepakshi (1,54,938.3/-) was found at par with dharani (1,25,476.0/-). The lowest gross returns was obtained with TAG-24. The highest gross returns with kadiri lepakshi was obviously due to higher pod and haulm yields.

With regard to nutrient levels, application of 75 kg N ha^{-1} resulted in highest gross returns of Rs 1,59,928.9/- was comparable with 50 kg N ha^{-1}(Rs 1,32,409.3/-) and 25 kg N ha^{-1} (Rs 1,29,630.2/-) The lowest gross returns was associated with control plot (0 kg N ha^{-1}). The higher level of nutrient application increased the gross returns owing to better nitrogen use efficiency resulting in increased pod and haulm yields. Similar results were reported by Tirumala Reddy *et al.* (2011), Meena *et al*. (2015) and Waghmode *et al*. (2017).

4.7.2 Net Returns (Rs. ha^{-1})

Net returns of groundnut was significantly influenced by different nitrogen levels and not influenced by varieties while interaction was found to be non- significant.

The highest net return obtained with nitrogen fertilization of 75 kg N ha^{-1} (Rs. 1,16,126.9/-) was found on par with 25 kg N ha^{-1} (86,029.7/-) and 50 kg N ha^{-1} (Rs 88,897.6 /-). The higher net return might be due to higher pod and haulm yields registered under higher nitrogen levels. The lowest net return was obtained from control plot (0 kg N ha^{-1}). Present investigation confirms the results reported by Reddy *et al.* (2011), Meena *et al*. (2015) and Waghmode *et al*. (2017).

The interaction between varieties and nitrogen levels however failed to produce significant results.

4.7.3 Benefit cost ratio

Benefit cost ratio of raising groundnut was significantly influenced by nitrogen levels but not influenced by varieties while the interaction was not statistically significant.

Maximum B:C ratio was recorded with 75 kg N ha^{-1} (2.6), which was on par with 25 kg and 50 kg N ha^{-1} (2.0). The lowest B:C ratio was recorded with control (0 kg N ha^{-1}). This could be due to manifestation of higher pod and haulm yields fetching of higher net returns at increased level of nitrogen. The similar results are found with Chitdeshwari *et al*. (2007).

Table 4.15. **Cost of cultivation (Rs. ha^{-1}), Gross returns (Rs. ha^{-1}), Net returns (Rs. ha^{-1}) and B:C ratio of groundnut as influenced by varieties and nitrogen levels**

Treatments	Cost of Cultivation (Rs. ha^{-1})	Gross Returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	B:C ratio
Varieties (V)				
V_1- Dharani	44, 266	1,25,476	81,210	1.8
V_2- Kadiri Lepakshi	46, 666	1,54,938	1,08,272	2.3
V_3- TAG- 24	39, 450	1,13,767	74316	1.9
SEm±	-	10217.84	10219.89	0.23
CD (P=0.05)	-	29965.2	NS	NS
Nitrogen levels (N)				
N_1- 0 kg N ha^{-1}	42,930	1,03,607	60,677	1.4
N_2- 25 kg N ha^{-1}	43,600	1,29,630	86,029	2.0
N_3- 50 kg N ha^{-1}	43,511	1,32,409	88,897	2.0
N_4- 75 kg N ha^{-1}	43,802	1,59,928	1,16,126	2.6
SEm±	-	11,798.55	11,800.91	0.27
CD (P=0.05)	-	34600.8	34607.7	0.8
Interaction (Vx N)				
SEm±	-	20435.6	20439.7	0.47
CD (P=0.05)	-	NS	NS	NS
CV (%)	-	8.9	13.6	13.4

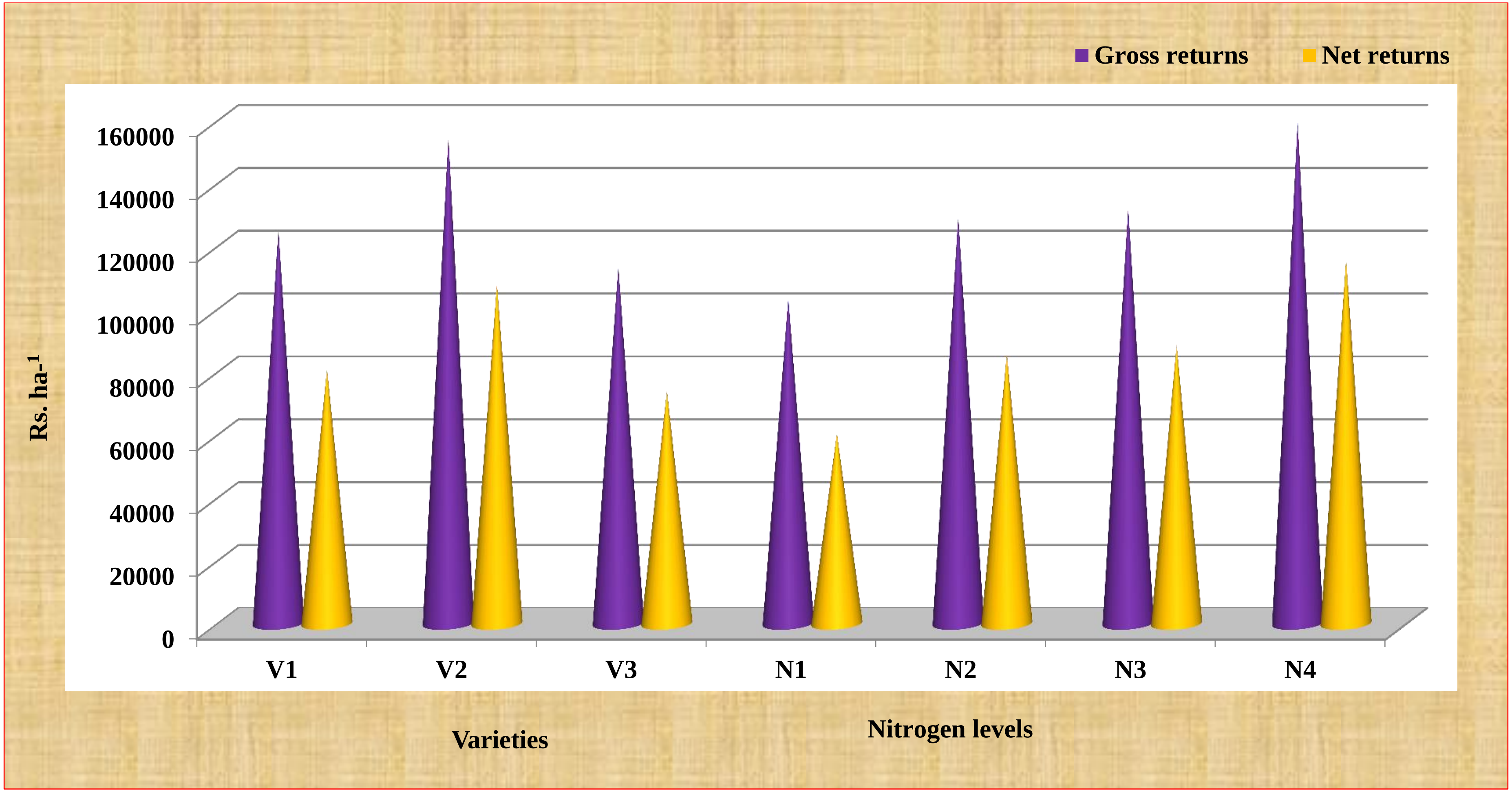

Fig. 4.9. Gross returns (Rs ha^{-1}) and Net returns (Rs ha^{-1}) of groundnut as influenced by varieties and nitrogen levels

Chapter-V

SUMMARY AND CONCLUSIONS

A field experiment entitled "**Potential performance of groundnut (*Arachis hypogaea* L.) varieties to levels of nitrogen''** was conducted during *rabi* 2020 on sandy loam soils of Agricultural College Farm, Bapatla, Acharya N.G. Ranga Agricultural University, Andhra Pradesh. The experiment was laid out in Randomized Block Design with factorial concept replicated thrice. The treatments consisted of three varieties V_1: Dharani, V_2: Kadiri lepakshi and V_3: TAG-24 and four nitrogen levels N_1: 0 kg N ha^{-1} N_2: 25 kg N ha^{-1} N_3: 50 kg N ha^{-1} and N_4: 75 kg N ha^{-1}.

Observations recorded on growth parameters were *viz*., initial and final plant population, plant height, number of branches $plant^{-1}$, drymatter accumulation, days to 50 % flowering, days to maturity, nodule dry weight $plant^{-1}$ with yield attributes including number of pods $plant^{-1}$, number of filled pods $plant^{-1}$, number of kernels pod^{-1}, 100 kernel weight (g), shelling percentage and pod yield, haulm yield as well as harvest index. Observations taken on quality parameters of groundnut comprised oil content (%), oil yield (kg ha^{-1}) and protein content. Further, observations were recorded on nutrient (N) uptake in plant sample and kernel respectively. Soil residual fertility of available N, P and K was evaluated after harvest of groundnut crop. Soil pH, Electrical conductivity and organic carbon was evaluated after harvest of groundnut crop. Economics comprising gross return, net return and B:C Ratio were also assessed. The salient findings of the investigation are summarized here under.

Most of the above mentioned parameters of groundnut were significantly influenced by varieties and nitrogen levels, whereas the interaction between varieties and nitrogen levels was found non-significant.

Initial and final plant population did not respond significantly with varieties and nitrogen levels and the interaction effect between varieties and nitrogen levels was also found non – significant.

Plant height differed significantly due to varieties and levels of nitrogen at 30, 60, 90 DAS and at harvest. Among the varieties dharani variety recorded the highest plant height at 30 DAS (14.9 cm) and was found superior to kadiri lepakshi and TAG-24. The lowest plant height was recorded with variety TAG-24 at 30DAS.

At 60, 90 DAS and at harvest the highest plant height was recorded with the variety dharani.

At all the stages of observation plant height increased significantly with increase in nitrogen application upto (75kg ha^{-1}). The lowest plant height was observed with no nitrogen application (0 kg N ha^{-1}). Significantly taller plants were observed with 75 kg N ha^{-1}.

Number of branches $plant^{-1}$ differed significantly with varieties and nitrogen levels. The highest number of branches $plant^{-1}$ was recorded with variety kadiri lepakshi at 60,90 DAS and at harvest, while the lowest number of branches $plant^{-1}$ was assosciated with variety dharani.

Drymatter accumulation (kg ha^{-1}) at all stages of crop growth was significantly influenced by both the varieties and nitrogen levels. Among the varieties the highest drymatter accumulation was recorded with kadiri lepakshi, which was however on par with dharani. Application of 75 kg N ha^{-1} recorded the highest drymatter accumulation which was statistically comparable with the application of 50 kg N ha^{-1}.

Though the number of days to reach 50 % flowering did not differ significantly either by varieties or nitrogen levels, their interaction was also found to be non- significant.

Though the number of days taken by groundnut to reach physiological maturity was influenced significantly by the varieties it was not so by the nitrogen levels.

Nodule dry weight did not differ significantly with varieties but was influenced significantly by nitrogen levels. Nodule dry weight was noticed to be distinctly higher with the treatment receiving 75 kg N ha^{-1} (1.116 g $plant^{-1}$) compared to control but was on a par with the supply of 25 kg N ha^{-1} and 50 kg N ha^{-1}.

Number of pods $plant^{-1}$ was not influenced significantly by varieties since it is governed by varietal characteristics. The highest number of pods $plant^{-1}$ was recorded with kadiri lepakshi (28.9) which exhibited significant superiority over dharani and TAG-24. Application of 75 kg $Nha^{-1}$to groundnut exhibited superior performance to other levels producing 26.2 $podsplant^{-1}$. However, it was comparable with the treatment receiving 50 kg N ha^{-1}. Number of filled pods $plant^{-1}$ also manifested non- significant behaviour due to varietal characteristics. The highest number of filled pods $plant^{-1}$ (15.0) was projected in the variety kadiri lepakshi, which was distinctly superior to dharani and TAG-24 varieties respectively.

Test weight of groundnut was significantly influenced by varieties but differed non-significantly with nitrogen levels. The highest kernel weight was recorded with dharani (42 gm) which displayed comparable performance with kadiri lepakshi (40 gm).

Shelling percentage of groundnut was not influenced significantly by varieties and nitrogen levels as well as their interaction.

Pod yield recorded was the highest with kadiri lepakshi (2979.6 kg ha^{-1}), which was however statistically comparable with dharani (2413.0 kg ha^{-1}). Among the nitrogen levels the highest pod yield was associated with the treatment supplying 75 kg N ha^{-1} (3075.6 kg ha^{-1}), which was however on par with the application of 25 kg N ha^{-1} as well as 50 kg N ha^{-1} respectively.

Haulm yield exhibited significant differences both in respect of varieties and nitrogen levels, while its interaction displayed negative result. Among the groundnut varieties tested variety kadiri lepakshi registered the highest haulm yield (4921.7 kg ha^{-1}) which was distinctly superior to other varieties but was on par with dharani (4502.8 kg ha^{-1}). With regard to the nitrogen levels, application of 75 kg N ha^{-1} registered the highest haulm yield, which was significantly superior to other treatments, but was statistically similar to the treatment supplied with 50 kg N $ha^{-1}$and 25 kg N ha^{-1} respectively.

Harvest index exhibited non- significant values with respect to either varieties or nitrogen levels.

Nitrogen content and uptake at different growth stages of groundnut had significant influence with varieties and nitrogen levels. Significant increase in nitrogen content and uptake (N) was assosciated with the variety kadiri lepakshi. The next best varieties were dharani and TAG – 24. Higher uptake of nitrogen (N) was observed with the application of 75 kg N ha^{-1}, which was on a par with 25 and 50 kg N ha^{-1}.

Among the varieties the highest oil content was registered with kadiri lepakshi (50.0 %), which was on par with variety dharani (48.1%). Oil content manifested non-significant values with nitrogen levels due to varietal characteristics.

Among the varieties the highest oil yield was registered with the variety kadiri lepakshi (1115.6 kg ha^{-1}), which was on a par with variety dharani (901.9 kg ha^{-1}). Oil yield did not differ significantly with nitrogen levels.

Protein content did not differ significantly with varieties but displayed significant differences with nitrogen levels. Among the nitrogen levels the highest protein content was recorded with 75 kg N ha^{-1}(25.7%), which was on a par with the treatment receiving 25 kg and 50 kg N ha^{-1} respectively.

The highest post – harvest soil available nutrient status (N, P and K) was recorded with the variety kadiri lepakshi followed by dharani and TAG – 24. The available nutrient status of soil (N, P and K) after harvest was analysed and it was observed that only soil available N was influenced significantly by levels of nitrogen. Higher available N was observed with 75 kg N ha^{-1}, which was on a par with 50 kg N ha^{-1}.

The highest gross return, net return and B:C ratio were recorded with the application of 75 kg N ha^{-1}, which was on a par with 25 kg and 50 kg N ha^{-1}. Among the varieties significantly the highest gross returns recorded with kadiri lepakshi and it was on par with dharani.

Based on the findings of the investigation, the following conclusions could be drawn:

1. The study has clearly revealed that the new generation groundnut cultivars were found to respond positively to higher doses of fertilizer. Among the varieties tested in the present study the cultivar kadiri lepakshi exhibited superior performance over dharani and TAG-24 in terms of growth and yield characteristics.

2. Application of nitrogen @ 75 kg N ha^{-1} displayed superior performance on the groundnut, but was however comparable with 50 kg N ha^{-1} and distinctly superior to 25 kg N ha^{-1} and without nitrogen application.

3. Higher gross returns, was obtained with the variety kadiri lepakshi due to higher pod yield compared to other varieties. Despite gross returns, net returns and B:C ratio found to be higher with the application of 75 kg N ha^{-1} and was found to be comparable with 50 kg N ha^{-1}.

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Note: The literature is cited as per the “Thesis Guidelines” prescribed by Acharya N. G. Ranga Agricultural University, Guntur.

APPENDIX - I

CALENDAR OF OPERATIONS

S No.	Operation	Date
1	Collection of initial soil samples for analyzing physio-chemical properties of the experimental area	03-12-2020
2	Land preparation	04-12-2020
3	Layout of the experiment and bund formation	06-12-2020
4	Basal application of fertilizers& Sowing was done	10-12-2020
5	Light irrigation was given after sowing	10-12-2020
6	Spraying of pre-emergence herbicide Alachlor uniformly to all the plots	11-12-2020
7	Gap filling	17-12-2020
8	First hand weeding	25-12-2020
9	First Split application of N fertilizer treatment wise 20DAS	31-12-2020
10	Second hand weeding	05-01-2021
11	Biometric observations recorded at 30DAS	10 -01-2021
12	Second Irrigation given at flowering stage	11-01-2021
13	Spraying of chlorpyriphos to control spodoptera damage	13-01-2021
14	Second split application of N fertilizer at 40DAS	20-01-2021
15	Third irrigation given at pod formation stage	21-01-2021
16	Gypsum was applied and plant protection measures were taken against diseases	22-01-2021
17	Biometric observations recorded at 60 DAS	10-02-2021
18	Biometric observations recorded at 90 DAS	10-03-2021
19	Biometric observations were recorded at harvest and light irrigation was given	07-04-2021
20	Harvesting, stripping and drying of pods	08-04-2021
21	Post-harvest observations were recorded and soil samples were collected for analysis	09-04-2021

APPENDIX-II

Input costs of the experiment

S.No.	Particular	Price
A	**INPUT**	
1	Groundnut Seed cost 1.Dharani 2.Kadiri lepakshi 3.TAG- 24	 120 Rs kg^{-1} 160 Rs kg^{-1} 110 Rs kg^{-1}
2	Chemical fertilizers	
	Urea	5.36 Rs. kg^{-1}
	SSP	7.48 Rs. kg^{-1}
	MOP	18.0 Rs. kg^{-1}
	Gypsum	6.0 Rs. kg^{-1}
3	Plant protection chemicals	
	Phorate 4G granules	80 Rs. kg^{-1}
	Chloropyriphos	250 Rs. L^{-1}
	SAAF (carbendazim + mancozeb)	300 Rs. kg^{-1}
	Novaluron	900 Rs. L^{-1}
	Thiomethoxam	650 Rs. L^{-1}
	Tebuconazole	850 Rs. L^{-1}

Plate 1. General view of the experimental field