

**“EFFICACY OF DIFFERENT ORGANIC
MANURES AND BIOFERTILIZERS ON
KASURI METHI (*Trigonella corniculata* L.)
var. PUSA KASURI UNDER TELANGANA
CONDITIONS”**

CHANDAN T K

B.Sc. (Hort.)

**MASTER OF SCIENCE IN HORTICULTURE
(PLANTATION, SPICES, MEDICINAL AND AROMATIC CROPS)**



**DEPARTMENT OF PLANTATION, SPICES, MEDICINAL AND
AROMATIC CROPS
COLLEGE OF HORTICULTURE, RAJENDRANAGAR, HYDERABAD-500030
SRI KONDA LAXMAN TELANGANA STATE
HORTICULTURAL UNIVERSITY**

DECEMBER, 2020

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By

CHANDAN T K

B.Sc. (Hort.)

THESIS SUBMITTED TO
SRI KONDA LAXMAN TELANGANA
STATE HORTICULTURAL UNIVERSITY
IN PARTIAL FULFILMENT OF THE REQUIREMENT
FOR THE AWARD OF THE DEGREE OF

**MASTER OF SCIENCE IN HORTICULTURE
(PLANTATION, SPICES, MEDICINAL AND AROMATIC CROPS)**



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DECEMBER, 2020

DECLARATION

I, **Mr. CHANDAN T K**, hereby declare that the thesis entitled **“EFFICACY OF DIFFERENT ORGANIC MANURES AND BIOFERTILIZERS ON KASURI METHI (*Trigonella corniculata* L.) var. PUSA KASURI UNDER TELANGANA CONDITIONS”** submitted to Sri Konda Laxman Telanagana State Horticultural University, Mulugu, Siddipet, for the degree of Master of Science in Horticulture (Plantation, Spices, Medicinal and Aromatic Crops) is the result of original research work done by me. I declare that no material contained in the thesis has been published earlier in any manner.

Place: Rajendranagar

Name : CHANDAN T K

Date:

I.D. No : RHM/18 - 02

CERTIFICATE

This is to certify that the thesis entitled “**EFFICACY OF DIFFERENT ORGANIC MANURES AND BIOFERTILIZERS ON KASURI METHI (*Trigonella corniculata* L.) var. PUSA KASURI UNDER TELANGANA CONDITIONS**” submitted in partial fulfillment of the requirements for the degree Master of Science In Horticulture (Plantation, Spices, Medicinal and Aromatic Crops) of Sri Konda Laxman Telangana State Horticultural University, Mulugu, Siddipet, is a record of the bonafide research work carried out by **Mr. CHANDAN T K** 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.

Thesis approved by the Student Advisory Committee.

Chairman: **Dr. D. Lakshminarayana**

Associate professor
Department of Horticulture
College of Horticulture
Rajendranagar, Hyderabad.

Member : **Dr. N. Seenivasan**

Professor
Department of Horticulture
Comptroller of Examinations
SKLTSHU, Mulugu, Siddipet.

Member : **Dr. Veena Joshi**

Associate professor
Department of Fruit Science
College of Horticulture, Mojerla.

Member : **Dr. S. Praneeth Kumar**

Scientist (Crop Physiology)
Floricultural Research Station,
Rajendranagar, Hyderabad.

Date of final viva-voce:

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Place: Hyderabad

(CHANDAN T K)

Date:

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LIST OF SYMBOLS AND ABBREVIATIONS

%	:	Per cent
/	:	Per
@	:	at the rate of
°C	:	Degree Celsius
AM	:	Arbuscular Mycorrhizae
B : C ratio	:	Benefit cost ratio
CD (P = 0.05%)	:	Critical Difference at 5 per cent level
cm	:	Centimetre
cm ²	:	Centimetre square
var.	:	Variety
DAS	:	Days after sowing
dSm ⁻¹	:	Decisiemen per metre
<i>et al.</i>	:	and others
Fig.	:	Figure
RBD	:	Randomized Block Design
FYM	:	Farm Yard Manure
g	:	Gram
g kg ⁻¹	:	Gram per kilogram
H ₂ SO ₄	:	Sulphuric acid
hrs	:	Hours

i.e	:	That is
INM	:	Integrated Nutrient Management
kg	:	Kilogram
kg ha ⁻¹	:	Kilogram per hectare
kg acre ⁻¹	:	Kilogram per acre
Km hr ⁻¹	:	Kilometre per hour
lit ha ⁻¹	:	Litre per hectare
m	:	Meter
mg	:	Milligram
ml	:	Millilitre
mm	:	Millimetre
MT	:	Metric tonnes
N, P, K	:	Nitrogen, Phosphorous, Potassium
NHB	:	National Horticulture Board
No.	:	Number
NS	:	Non significant
P ₂ O ₅	:	Phosphorous pentoxide
pH	:	Hydrogen ion concentration
plant ⁻¹	:	Per plant
plot ⁻¹	:	Per plot
PSB	:	Phosphate solubilising bacteria
q	:	Quintal
q ha ⁻¹	:	quintal per hectare
RDF	:	Recommended Dose of Fertilizers

RDN	:	Recommended Dose of Nitrogen
RD PK	:	Recommended Dose of Phosphorous and Potassium
RD NPK	:	Recommended Dose of Nitrogen, Phosphorous and Potassium
RH	:	Relative humidity
₹	:	Rupees
SEm ±	:	Standard error of mean
t	:	Tonne
T	:	Treatment
t ha ⁻¹	:	Tonnes per hectare
umbel ⁻¹	:	Per umbel
VC	:	Vermicompost
viz.,	:	Namely

Name of the author : **CHANDAN T K**

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Major Advisor : **Dr. D. LAKSHMINARAYANA**

University : **SRI KONDA LAXMAN TELANGANA STATE HORTICULTURAL UNIVERSITY**

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ABSTRACT

The present investigation entitled “Efficacy of different organic manures and biofertilizers on kasuri methi (*Trigonella corniculata* L.) var. Pusa Kasuri under Telangana conditions” was carried out during the *rabi* season of the year 2019-20 at College of Horticulture, Rajendranagar, Hyderabad.

The results related to growth parameters indicated that, among all treatments, T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded higher plant height (42.07 cm), more number of branches per plant (25.02) and significantly maximum plant spread (North-South 29.82 cm and East-West 31.20 cm) over other treatments.

All treatments differed significantly with respect to yield parameters. Among the treatments, T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded significantly highest fresh herb yield per plant and per hectare (24.63 g and 8090.53 kg, respectively), dry herb yield per plant and

per hectare (5.78 g and 1615.69 kg, respectively), maximum number of days taken to first and 50 per cent flowering (64.87 days and 95.55 days, respectively), significantly more number of pods per plant (634.56), maximum pod length (2.02 cm), maximum number of seeds per pod (6.03) and the same treatment also registered significantly highest seed yield per plant and per hectare (1.61 g and 482.41 kg, respectively) and the maximum test weight (1.63 g) as compared to other treatments.

The results pertaining to quality parameters revealed significantly highest crude protein content of herb and highest crude protein content in seed (9.57% and 19.53%, respectively) and significantly highest total chlorophyll content (22.69 mg 100 mg⁻¹ of tissue) were recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) over other treatments.

The results related to soil and plant nutrient status showed that, among the treatments, T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) significantly recorded maximum availability of nitrogen (205.80 kg ha⁻¹), significantly more phosphorous (44.70 ha⁻¹) and higher potassium content (165.45 kg ha⁻¹) in soil and also the same treatment registered significantly maximum nitrogen, phosphorous and potassium content in herb, straw and seed (1.43%, 1.19% and 2.95%, 0.59%, 0.39% and 0.58%, 0.59%, 0.79% and 0.38% , respectively) as compared to rest of the treatments.

The data on economics revealed that, among the treatments, T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded the highest gross returns (₹ 238996.2), net returns (₹ 160416.2) with benefit cost ratio (2.04: 1) over other treatments.

Chapter III

MATERIAL AND METHODS

Chapter II

REVIEW OF LITERATURE

Chapter I

INTRODUCTION

Chapter IV

RESULTS AND DISCUSSION

Chapter V

SUMMARY AND CONCLUSIONS

CERTIFICATE

Mr. CHANDAN T K has satisfactorily prosecuted the course of research and that the thesis entitled “EFFICACY OF DIFFERENT ORGANIC MANURES AND BIOFERTILIZERS ON KASURI METHI (*Trigonella corniculata* L.) var. PUSA KASURI UNDER TELANGANA CONDITIONS” submitted is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination.

I certify that neither the thesis nor part there of has not been previously submitted by him for a degree of any University.

Date :

(Dr. D. Lakshminarayana)

Place: Rajendranagar, Hyderabad

Chairman

Name of the author : **CHANDAN T K**

Title of the thesis : **“EFFICACY OF DIFFERENT ORGANIC MANURES AND BIOFERTILIZERS ON KASURI METHI (*Trigonella corniculata* L.) var. PUSA KASURI UNDER TELANGANA CONDITIONS”**

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Chapter I

INTRODUCTION

Kasuri methi is an herbaceous, bushy, slow growing annual spice crop native to the Mediterranean region. It's diploid chromosome number is $2n=16$. It has many regional names like '*Champa methi*' and '*Marwari methi*' (Hindi), *Piring* (Assami) and in English it is popularly called as sickle fruited fenugreek.

The genus *Trigonella* of the family Fabaceae, consists of two economically important species, viz. *T. foenum graecum* (Common methi) and *T. corniculata* (Kasuri methi). Kasuri methi got its name from Kasuer, a place in Pakistan. Kasuri methi is a diffuse sub-erect strongly scented annual herb and it remains in rosette condition during most of the vegetative growth period.

Kasuri methi is mainly grown in India, Pakistan, China, Nepal and Bangladesh. In India, it is commercially grown in Rajasthan, Gujarat, Madhya Pradesh, Haryana, West Bengal, Punjab and Maharashtra. Rajasthan occupies 80 per cent of area and production (Babaleshwar and Shetty, 2017).

Kasuri methi is a semi arid crop, grows up to height of 30 cm or more and its leaves are pinnate shape with size of leaflets being 1.25-2.0 cm and consists bright orange-yellow coloured flowers. Pods are 1.2-2.2 cm long, sickle shaped with 4-8 seeded number.

Kasuri methi is mainly grown for herbage as well as for seed and used as a spice to add aroma and flavor to the food products. It is a vital source of essential minerals, vitamins and dietary fibers. The green leaves contain several alkaloids like trigonelline, choline, gentianine and carpaine and is also a rich source of vitamins such as carotene ($2.34 \text{ mg } 100\text{g}^{-1}$ of fresh edible portion), thiamine (0.04 mg), riboflavin (0.31 mg), nicotinic acid (0.8 mg) and vitamin C ($52.0 \text{ mg } 100\text{g}^{-1}$ of edible portion).

Kasuri methi seeds are rich in proteins, minerals and vitamins and also contains volatile oil, fixed oil, cellulose, starch, sugars, alkaloids and enzymes. The volatile oil content in the seed is low (0.02%), but it is extremely odoriferous due to a compound called 3-hydroxy-4, 5-dimethyl- oxolane-2 furanone. The fixed oil (7.6%) has a very bitter taste (Brenac and Sauvaire, 1996). Seeds are also used commercially in the preparation of syrup, pickles, baked foods, condiments, chewing gums and cooked food seasonings. In certain parts of Northern India, the green herbage as well as the seeds with other green and dry fodder is usually fed to the cattle.

Kasuri methi is a multipurpose crop. Its every part is useful and is utilized in one or the other forms as food, fodder, medicine and in cosmetics. The fresh green leaves are used for salads and as cooked vegetable and the shade dried leaves, which are having aromatic qualities are used as spice for seasoning a variety of foods in off season. Being odoriferous, the dry seeds and their powder are used as condiment/flavoring agent and for medicinal purposes.

Presently Kasuri methi cultivation is confined to North Indian States only. However, due to increase in its usage as well as an assured remuneration, there is a need to expand the area under this valuable spice crop. Improper nutrient management is one of the major reason which causes lower yield and poor quality seed in Kasuri methi.

Global awareness on health and environmental issues is spreading fast in recent years. Sustainability in production has become the prime concern in agriculture development. Hence, of late people all over the world have realized the ill effects of chemical farming in the long run which pollutes soil, water and air resulting in environmental degradation. They are also aware that soil is also like any living entity with large amount of micro flora which will also be affected by continuous conventional chemical farming.

World Health Organization (WHO) and World Trade Organization (WTO) have realized and emphasized the need of organic cultivation with special reference to spices and medicinal and aromatic plants. It is true that the quality of

any produce particularly spices and medicinal plants improve when nutrients are supplied through organic manures than chemical fertilizers. This is because of improved soil physical, chemical and biological properties and supplies all the growth principles, enzymes, hormones, growth-regulators besides supplying all the essential plant nutrients.

Hence, Organic farming is the best option to ensure that the air, water and soil around us remain unpolluted, leaving the environment safe for present and future generations. Hence, internationally, there is definite shift towards organically produced food and spice products and demand for organically produced spice and medicinal products would grow in future as well.

Kasuri methi is mainly grown as a *rabi* season crop and the cultivation methods are more or less similar to that of common methi. The nutrient requirement of the crop through organic sources and biofertilizers are not studied so far under Telangana conditions. Hence, there is a need to workout the optimum dose of nutrients from different organic manures and biofertilizers on Kasuri methi (*Trigonella corniculata* L.) var. Pusa Kasuri under Telangana conditions.

Keeping in view of the above mentioned facts, the present investigation was designed to study the **“Efficacy of different organic manures and biofertilizers on Kasuri Methi (*Trigonella corniculata* L.) var. Pusa Kasuri under Telangana conditions”** with the following objectives.

1. To study the effect of organic manures and biofertilizers on plant growth attributes of Kasuri methi var. Pusa Kasuri.
2. To study the influence of organic manures and biofertilizers on herbage, seed yield and quality of Kasuri methi var. Pusa Kasuri.

Chapter III

MATERIAL AND METHODS

The present investigation entitled “Efficacy of different organic manures and biofertilizers on Kasuri methi (*Trigonella corniculata* L.) var. Pusa Kasuri under Telangana conditions” was carried out during 2019-20 at College of Horticulture, Sri Konda Laxman Telangana State Horticultural University Rajendranagar, Hyderabad. The details of the location, the material used and the techniques adopted during the period of experimentation are presented in this chapter in the following headings and sub headings.

3.1 GEOGRAPHICAL LOCATION AND WEATHER CODITIONS OF THE EXPERIMENTAL SITE

The experimental site, Rajendranagar is situated at an altitude of 536 m above mean sea level on 78°.40' East longitude and 17°.32' North latitude. The climate of Rajendranagar is semi-arid. Data on weather parameters during the period of investigation recorded at the Agriculture Research Institute, Rajendranagar are presented in Appendix I.

3.2 SOIL CHARACTERISTICS OF THE EXPERIMENTAL SITE

The soil of the experimental site was loamy with a pH of 7.2 and Electrical Conductivity of 0.18 dSm⁻¹. The organic carbon content is very low. The available nitrogen, phosphorous and potash per hectare is 205.80, 44.7 and 165.45 kilograms, respectively.

3.3 SEED MATERIAL

The experiment was carried out with the variety Pusa Kasuri, procured from IARI, New Delhi.

3.4. DESCRIPTION OF THE CULTIVAR PUSA KASURI

The variety Pusa Kasuri consists of rosette type leaves with special fragrance, bear yellow coloured flowers and gives 2-3 cuttings of herbal yield per season and its average yields are 60-75 quintals per hectare.

3.5 CULTURAL PRACTICES

3.5.1 FIELD PREPARATION

The experimental field was brought to fine tilt by ploughing and harrowing. The land was levelled and the experimental area was divided in to plots of 2 × 2 m size. Bunds of 0.3 m size were prepared between two plots as a demarcation purpose (Plate 1).

3.5.2 SOWING OF SEEDS

The seeds of the variety Pusa Kasuri were used with the seed rate of 18 - 20 kg ha⁻¹. Seeds were sown on 20th October, 2019 at a spacing of 30 × 10 cm. Seeds were properly covered with a thin layer of soil and the plots were irrigated lightly.

3.5.3 THINNING OF SEEDLINGS

The excess seedlings were thinned out manually at 15 days after sowing and two healthy vigorous seedlings were retained per hill. Final thinning was done at 30 days after sowing, retaining only one seedling per hill to maintain optimum population.

3.5.4 APPLICATION OF ORGANIC MANURES AND BIOFERTILIZERS

Organic manures viz., well decomposed farm yard manure, neem cake and vermicompost were weighed separately for all the plots, according to the treatments and then applied to the respective plots one week prior to sowing and incorporated in to the soil uniformly.

The biofertilizer AMC (Arka Microbial Consortium) was applied as soil application.

3.6 AFTER CARE

3.6.1 WEEDING AND IRRIGATION

The experimental plots were kept free from weeds by using wheel hoe weeder and hand weedings were done at 20, 45, 70 and 95 days after sowing. Irrigation was given at an interval of 3- 4 days by micro sprinkler system during the entire cropping period and irrigation was given depending on the soil moisture conditions. About 32 irrigations were given during the whole cropping period.

3.6.2 PLANT PROTECTION

Prophylactic plant protection measures were taken to control pest and disease incidence at regular intervals. During crop period, cut worms are the major problem at seedling stage so neem oil at 1 %, sprayed for 3 times at weekly interval.

3.7 HARVESTING

The crop was grown for both herbage and seed purpose. After harvesting the herbage crop, the plants were left for seed crop.

3.7.1 HERBAGE CROP

Herb cutting was done at 60 days after sowing and plants were cut at 4-5 cm above the ground level with the help of a sharp and cleaned knife and then allowed for regeneration for seed purpose. The harvesting of herb was done in two months after planting and was cleaned and dried under shade conditions.

3.7.2 SEED CROP

Around 120 days were taken from the date of sowing to reach the seed maturity. After a week the crop was harvested when the plants as well as the

Pods turned yellow colour and mature pods having red to brown colour seeds. The whole plants were cut and dried under partial shade conditions and it has taken about 5-6 days and then seeds were collected by adopting threshing and winnowing operations.

3.8 EXPERIMENTAL DETAILS

3.8.1 Layout details

Crop	: Kasuri methi (<i>Trigonella corniculata</i> L.)
Variety	: Pusa Kasuri
Total number of Treatments	: 11
Number of Replications	: 3
Design	: Randomized Block Design
Season	: 2019-20, <i>Rabi</i>
Plot size	: 2 × 2 m
Spacing	: 30 × 10 cm
Location	: PG Research Block, COH, Rajendranagar, Hyderabad

3.8.2 Treatment details

- T₁ - 100% RDN through FYM (16 t ha⁻¹) + AMC (7.5 lit ha⁻¹)
- T₂ - 100% RDN through Neem cake (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹)
- T₃ - 100% RDN through Vermicompost (4 t ha⁻¹) + AMC (7.5 lit ha⁻¹)
- T₄ - 75% RDN through FYM (12 t ha⁻¹) + AMC (7.5 lit ha⁻¹)
- T₅ - 75% RDN through Neem cake (1.5 t ha⁻¹) + AMC (7.5 lit ha⁻¹)
- T₆ - 75% RDN through Vermicompost (3 t ha⁻¹) + AMC (7.5 lit ha⁻¹)
- T₇ - 50% RDN through FYM (8 t ha⁻¹) + AMC (7.5 lit ha⁻¹)
- T₈ - 50% RDN through Neem cake (1 t ha⁻¹) + AMC (7.5 lit ha⁻¹)
- T₉ - 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹)

T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹)

T₁₁ - Control (without any application)

Note :

Recommended dose of fertilizers : (NPK- 80:50:50 kg ha⁻¹)

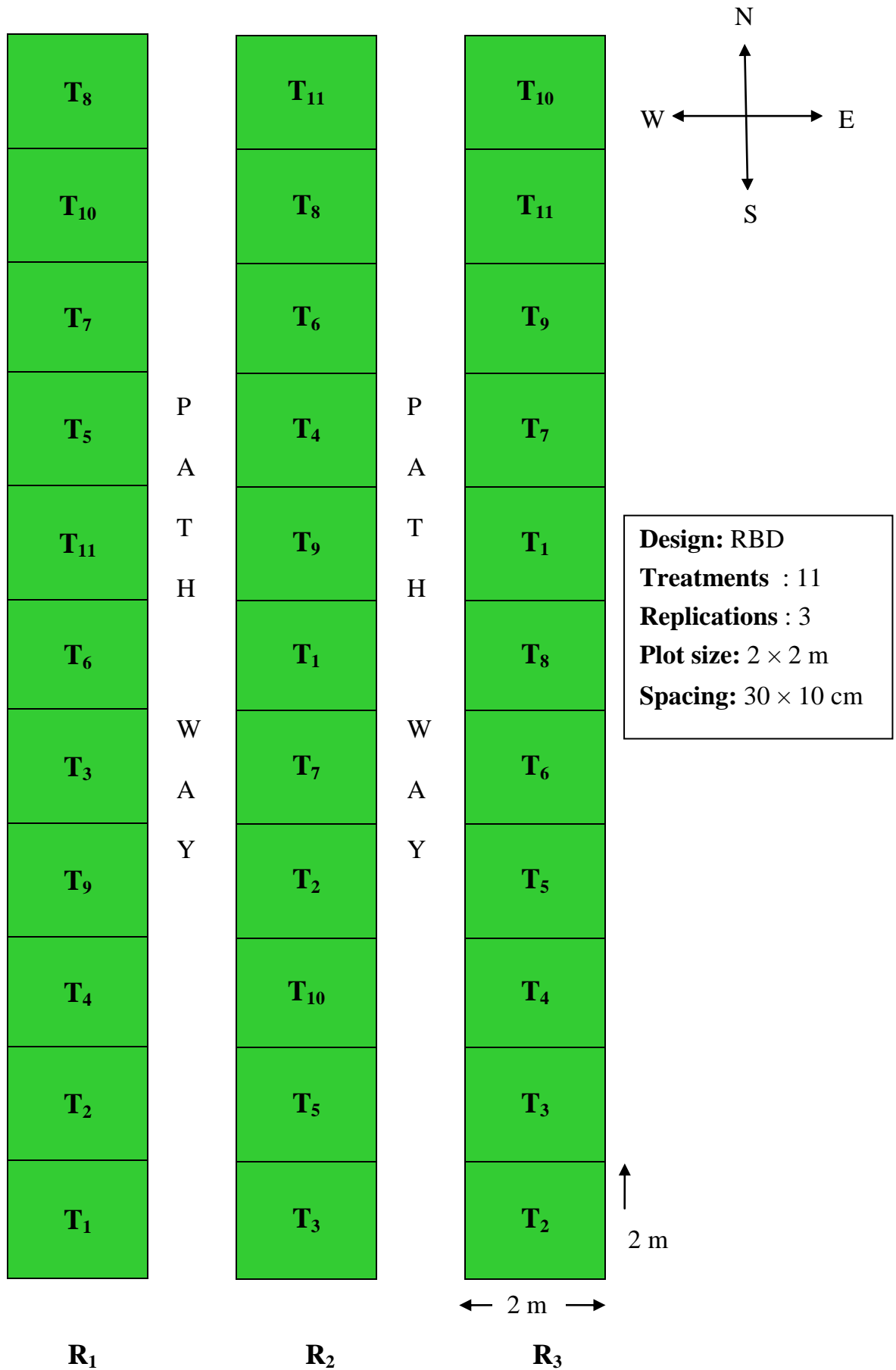


Fig. 3.1.1 Plan and Layout view of the experimental site

3.9 DETAILS OF OBSERVATIONS RECORDED

Data on following characters were recorded during the course of investigation. Uniformly growing five plants were randomly selected and tagged in each treatment and replication for the purpose of recording observations.

3.9.1 GROWTH PARAMETERS

3.9.1.1 Plant height

It was measured from base of the plant to the growing tip at 30, 60, 90 days after sowing and at the time of harvest with the help of scale and expressed in centimetres.

3.9.1.2 Number of branches per plant

Number of branches per plant were counted at the 30, 60, 90 DAS and at the time of harvest and expressed in number.

3.9.1.3 Plant spread

It was calculated at 30, 60, 90 DAS and at the time of harvest by measuring towards North-South and East-West directions with the help of tape and averages were expressed in centimetres.

3.9.2 YIELD PARAMETERS

3.9.2.1 Fresh herb yield per plant

Sixty days old plants were harvested for herbage purpose and cleaned herb was weighed by using electronic balance and averages were expressed in gram.

3.9.2.2 Fresh herb yield

Total fresh herb yield per plant was initially computed by using an electronic balance and mean figures were worked out and per hectare and expressed in kilograms.

3.9.2.3 Dry herb yield per plant

After recording the fresh herb yield per plant, the plants were dried under partial shade and when they attained constant weight, it was weighed with the help of an electronic balance and mean value was expressed.

3.9.2.4 Dry herb yield per hectare

Total dry herb yield per plant was initially computed by an electronic balance and the averages were calculated per hectare and expressed in kilograms.

3.9.2.5 Days taken to 1st flowering

Number of days taken for the first flowering from the time of sowing was counted and expressed in days.

3.9.2.6 Days taken to 50 per cent flowering

Number of days taken for the fifty per cent of the plants to come to flowering was recorded and expressed in days.

3.9.2.7 Number of pods per plant

Number of pods per plant was counted and the mean value was expressed in number.

3.9.2.8 Length of pod

It was measured with the help of a measuring scale and averages were calculated and expressed in centimetres.

3.9.2.9 Number of seeds per pod

Numbers of seeds per pod were counted and mean value was expressed in number.

3.9.2.10 Seed yield per plant

Total weight of seeds per plant was recorded by using an electronic balance and averages were expressed in gram.

3.9.2.11 Seed yield per hectare

Total seed yield per plot was initially computed by an electronic balance and then averages were worked out per hectare and expressed in kilograms.

3.9.2.12 Test weight (1000 seed weight)

The 1000 number of seed weight was taken by using an electronic balance and expressed in gram.

3.9.3 Quality parameters

3.9.3.1 Crude protein content

It was calculated by multiplying the nitrogen content of the leaves and the seeds by 6.25 and mean value was expressed in percentage.

3.9.3.2 Chlorophyll content

. Chlorophyll 'a', 'b' and total chlorophyll content of leaf tissue were determined by non destructive method of chlorophyll estimation by using dimethyl sulphoxide (DMSO) as suggested by Shoaf and Lium (1976).

Healthy, fully opened, matured leaves from the centre portion of the plants were collected in polyethylene bags and cut into small pieces. Known weight of sample (100 mg) was incubated in 7.0 ml DMSO at 65⁰C for 60 minutes. After the incubation, supernatant was collected by decanting. Then the volume of supernatant was made up to 10 ml by using DMSO.

$$\text{Chlorophyll 'a' (mg/ g tissue)} = \frac{[12.7 (A_{663}) - (2.69 \times A_{645})] \times V}{1000} \times W$$

$$\text{Chlorophyll 'b' (mg/ g tissue)} = \frac{[22.9 (A_{645}) - (4.68 \times A_{663})] \times V}{1000} \times W$$

V

$$\text{Total chlorophyll (mg/ g tissue)} = \frac{[20.2 (A_{645}) + (8.02 A_{663})] \times W \times a}{1000}$$

A = Absorbance at specific wavelengths 645 nm and 663 nm

V = Volume of the extract (10 ml)

W = Fresh weight of the sample (100 mg)

a = Path of light in cuvette (1cm)

3.10 SOIL AND PLANT NUTRIENT STATUS

3.10.1 Available nutrients (NPK) in the soil before sowing and after harvesting the crop

Before application of integrated nutrient sources to the experimental site, a composite soil sample was collected, to know the initial nutrients status of the soil. After the crop was harvested, soil samples were again collected at a depth of 30 cm from each treatment using screw auger.

The collected soil samples were mixed thoroughly and spreaded on cotton cloth bags for air drying purpose. Then the samples were ground and sieved through 2 mm sieve, and the same was used for the estimation of available nitrogen, phosphorus and potassium content of the soil.

3.10.1.1 Available nitrogen (kg ha⁻¹)

Available nitrogen in soil was estimated by the alkaline permanganate oxidation method (Subbaiah and Asija, 1956).

3.10.1.2 Available phosphorus (kg ha⁻¹)

Available phosphorus in soil was determined by Olsen's method as described by Jackson (1967).

3.10.1.3 Available potassium (kg ha⁻¹)

Exchangeable potassium in the soil was extracted with neutral normal ammonium acetate and the potassium in the filtered extract was estimated by flame photometry by Black (1965).

3.10.2 Chemical analysis of plant samples

3.10.2.1 Nitrogen content

The plant samples from each plot were collected randomly at harvest stage of the crop and were oven dried at 60 °C temperature for about 48 hours. Grinding of oven dried plant and the wet digestion (2:1 nitric acid and perchloric acid) of plant samples were carried out. The method adopted for the estimation of nitrogen in plant is discussed briefly as under.

The N content in plant samples was determined by following the method as described by AOAC (1995). Nitrogen was estimated by Micro-Kjeldhal method, for which 0.5 g of dry plant sample was taken and digested in 200 ml tube with concentrated H₂SO₄ (10 ml) in presence of triple salt mixture consisting of potassium sulphate and copper sulphate.

The digested material was transferred to distillation unit and was distilled with 40 ml of 40% sodium hydroxide solution. The distilled ammonia was collected in 4% boric acid solution containing mixed indicator kept in 250 ml conical flask. After complete distillation, the distillate was titrated against 0.02 N standard sulphuric acid.

The equivalent amount of nitrogen was calculated and results were expressed as content of nitrogen in per cent. The nitrogen content in the plant samples was estimated by Micro Kjeldhal method (AOAC, 1995) and expressed in percentage on dry weight basis.

3.10.2.2 Determination of phosphorous and potassium

Extraction: One gram of oven dried plant sample was digested in di-acid mixture consisting of 900 ml conc. HNO₃ + 400 ml of per chloric acid on hot plate till clear solution was obtained. The digested material was filtered through

Whatman filter paper No. 40 and diluted to 100 ml. Filtrate was used for determination of Phosphorous (P) and Potassium (K).

3.10.2.3 Determination of phosphorous

The phosphorus content of the di-acid digested plant sample was determined by Vanado molybdo phosphoric yellow colour method (Jackson, 1967) and expressed in percentage on dry weight basis.

3.10.2.4 Determination of potassium

The potassium content in plant samples was determined by flame photometer method as described by Jackson (1967) and expressed in percentage on dry weight basis.

3.11 ECONOMIC ANALYSIS

Economics is the most important consideration for making any recommendation to the farmers for its wide adoption. It was computed by dividing gross return with cost of cultivation for each treatment. The details of economics for each treatment are given in appendix II.

3.12 STATISTICAL ANALYSIS

The data were analysed statistically by following the analysis of variance (ANOVA) technique as asserted by Panse and Sukhatme (1985). Statistical significance was tested with 'F' value at 5% level of probability and whenever the F value was found significant. Critical difference was worked out at five per cent level of probability.



Plate 2. Flowering of T₁₀ treatment (50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹))

Chapter II

REVIEW OF LITERATURE

The pertinent literature concerning to the effect of organic manures and biofertilizers on plant growth, seed yield and quality of kasuri methi and other related seed spice crops is reviewed in this chapter under the following heads.

2.1 Effect of organic manures and biofertilizers on growth and yield parameters

2.2 Effect organic manures and biofertilizers on quality parameters

2.3 Effect of organic manures and biofertilizers on soil and plant nutrient status

2.4 Effect of organic manures and biofertilizers on Benefit Cost ratio

2.1 EFFECT OF ORGANIC MANURES AND BIOFERTILIZERS ON GROWTH AND YIELD PARAMETERS

Parakhia *et al.* (2000) observed that the co-inoculation of *Azotobacter* with *Rhizobium* resulting in maximum nodulation (23.13 plant⁻¹) followed by *Azotobacter* alone (21.72 plant⁻¹) in fenugreek. They also recorded significantly higher in fresh and dry weight of the nodules, plant spread, number of pods per plant, fresh and dry weight of shoot and roots over other treatments.

Khiriya *et al.* (2001) studied the growth of fenugreek (*Trigonella foenum-graecum* L.) under various levels of farmyard manure and phosphorous and reported significantly higher plant height and dry matter accumulation with increase of FYM up to 15 t ha⁻¹ at all stages of crop growth, except at 30 DAS. Seed yield was also enhanced significantly with FYM up to 15 t ha⁻¹.

Kumawat *et al.* (2003) revealed that seed inoculation with *Rhizobium* culture significantly increased all the growth and yield attributes and seed, straw and biological yields and net return over uninoculated control in fenugreek plant.

Shivaran *et al.* (2005) cited that the interaction effect of N and *Rhizobium* inoculation produced significantly higher plant height, number of branches, total dry matter accumulation and plant spread in fenugreek. The highest seed yield (13.4 q ha⁻¹) was obtained with 30 Kg N ha⁻¹ coupled with inoculation of *Rhizobium* strain-12.

Aiyanathan and Salairajan (2008) conducted an experiment on organic amendments for management of root rot of fenugreek and reported the mean root rot incidence which was reduced to 4.8, 5.7 and 6.0 per cent by neem cake, FYM and poultry manure, respectively compared to control 25.6 per cent and also resulted in increase in plant height, number of branches, plant spread, dry matter accumulation and yield attributes compared to untreated control.

In coriander application of FYM 20 t ha⁻¹ with 30 × 20 cm spacing recorded maximum plant height, number of leaves per plant, number of umbels per plant, number of umbelets per umbel, number of seeds per umbellate, number of seeds per plant and seed yield per plant. While seed yield per plot and per hectare were maximum in FYM 20 t ha⁻¹ with 30 × 10 cm spacing. Vasmate *et al.* (2008).

Azzaz *et al.* (2009) investigated that the highest seed yield per plant was obtained by the combined application of cattle manure and biofertilizers treatment in fennel.

Kumawat and Yadav (2009) observed that application of 10 t ha⁻¹ of FYM increased the plant height by 35.3 per cent and total number of root nodules per plant by 38.6 per cent as compared to control in fenugreek.

Naidu *et al.* (2010) conducted a field experiment on effect of different organic sources of nutrients on growth, yield and quality of fenugreek and reported that application of FYM @ 2.8 t ha⁻¹ + poultry manure @ 3.5 t ha⁻¹ was found promising and could be recommended for obtaining higher yield.

Naveen (2010) reported that in Kasuri methi, application of biofertilizers along with cow urine and neem cake recorded the maximum plant height (50.10

cm), number of branches per plant (24.5), plant spread (793.0 cm²) and dry matter accumulation per plant (22.14 g) at harvest time.

Dutta *et al.* (2011) conducted an experiment on response of fenugreek (*Trigonella foenum-graecum*) to different levels of nitrogen and *Rhizobium* and reported that application of 75 per cent of recommended dose (RD) of Nitrogen + RD of phosphorous and potassium + FYM + *Rhizobium* recorded maximum plant height, number of branches per plant and seed yield.

Ahmed *et al.* (2012) studied the influence of organic and biofertilizer on growth and yield of two fenugreek cultivars grown in sandy soil. They observed that addition of organic and biofertilizers (FYM + *Rhizobium* + Yeast) resulted the greatest values for growth, yield and yield components, at 100 days after sowing.

Aishwath *et al.* (2012) revealed that maximum plant height, more number of primary and secondary branches, numbers of umbellate per umbel, highest seed, straw and biological yields were recorded in the treatment supplied with *Azotobacter*, Phosphate solubilizing bacteria and their combinations of both in coriander.

Lal *et al.* (2012) observed that in coriander soil application of vermicompost, *Trichoderma* and neem cake as well as seed treatment of *Azotobacter*, Phosphate solubilizing bacteria and *Trichoderma*, with the foliar spray of garlic extract and neem oil exhibited maximum values for all the yield attributing characters like days taken to 50 per cent flowering, number of umbels per plant, number of umbellate per umbel, number of seeds per umbellate, seed yield per hectare and test weight.

Mehta *et al.* (2012) revealed that maximum plant height and more number of branches per plant were recorded with the combined application of vermicompost and *Azotobacter* as compared to other treatments in cumin.

Sharma *et al.* (2012) studied the application of biodynamic preparations and organic manures for organic production of cumin (*Cuminum cyminum* L.) and revealed that integrated use of organic manure + biodynamic preparations

(Biodynamic 500 and Biodynamic 501) resulted in maximum increase of yield attributes.

Siamak and Seyed (2012) reported that plant height, seed yield, seed weight, biological yield and harvest index had the highest values in compost treatment over other treatments in cumin.

Rizvi *et al.* (2013) conducted an experiment on potential role of organic matter and Phosphate solubilizing bacteria (PSB) on growth and productivity of fenugreek. They reported maximum growth and productivity in the combined inoculation of neem cake, castor cake, *Calotropis procera* and Phosphate solubilizing bacteria.

Patel *et al.* (2013) studied the effect of different sources of organic manures with and without biofertilizers in cumin (*Cuminum cyminum* L.) and reported that application of 100 per cent Nitrogen through FYM + *Azotobacter* + Phosphate solubilizing bacteria recorded maximum plant height, number of branches per plant, number of umbellate per umbel, number of seeds per umbellate, test weight and seed yield (kg ha^{-1}).

Ali and Hassan (2014) obtained maximum vegetative growth and seed yield with the combined application of cattle combined with a mixture of Nitrogen fixing bacteria + Phosphate solubilizing bacteria in black cumin.

Biswas and Anusuya (2014) studied the effect of bioinoculants and organic manure (phosphocompost) on growth, yield and nutrient uptake of fenugreek (*Trigonella foenum-graecum* L.) and concluded that combined inoculation with bioinoculants viz., *Fratureuria aurentia* (Potassium mobilizer), phosphocompost i.e, *Trichoderma viridae*, *Rhizobium* spp. and *Pseudomonas fluorescens* significantly increased the plant biomass, yield and nutrient content.

Mohammadi *et al.* (2014) conducted an experiment on influence of compost and biofertilizer on yield and essential oil of dill (*Anethum graveolens*

L.) and obtained the maximum seed yield and essential oil yield with the combined application of compost @ 10 t ha⁻¹ and biofertilizer.

Naimuddin *et al.* (2014) reported that application of FYM and *Rhizobium* inoculation enhanced the growth and yield parameters *viz.*, highest plant height, more number of branches per plant, number of pods plant⁻¹, number of seeds pod⁻¹, maximum test weight and seed yield in fenugreek.

Patel *et al.* (2014) studied the effect of different organic manures and biofertilizers on yield, nutrient uptake and economics of fenugreek (*Trigonella foenum-graecum* L.) under organic farming. Results revealed that conjunctive use of 50 per cent RDN through castor cake + *Rhizobium* and Phosphate solubilizing bacteria, remarkably improved soil fertility compared to RDF through inorganic fertilizers and sole application of either organic manures or biofertilizers.

Forouzandeh *et al.* (2015) revealed that application of compost @ 15 t ha⁻¹ resulted in maximum number of umbels per plant, umbellate per umbel and seed per umbel, while application of 30 t ha⁻¹ animal manure produced the highest seed yield (316.39 kg ha⁻¹) and thousand seed weight (4.61g) in cumin.

Kumar *et al.* (2015) recorded the maximum plant height, number of primary and secondary branches, number of umbels per plant, number of umbellate per umbel, number of seeds per umbel, weight of 1000 seeds and seed yield with the application FYM 25% (5 t ha⁻¹) + vermicompost 75% (3.75 t ha⁻¹) in coriander.

Mohammad Reza Haj *et al.* (2015) conducted an experiment on influence of compost and biofertilizer on yield and essential oil content of dill (*Anethum graveolens* L.) and reported the highest plant height, 1000 seed weight, seed number per follicle, follicle yield, seed yield and harvest index in black cumin and obtained the maximum values in the crop treated with manure @ 5 t ha⁻¹ along with *Azotobacter* and *Azospirillum*.

Application of 50% RDF vermicompost + 25% RDF through neemcake + 25% RDF through FYM, emerged superior in growth attributes as well as yield and gave maximum seed yield (19.76 q ha^{-1}) of coriander (*Coriandrum sativum*) under subabul (*Leucaena leucocephala*) alley cropping system. Agarwal *et al.* (2016).

Badar *et al.* (2016) studied the influence of biofertilizers for improving the growth of fenugreek plants (*Trigonella foenum-graecum* L.) and concluded that, two rhizobial species I and II, isolated from fenugreek and *Melilotus alba* promoted all growth parameters such as root and shoot lengths, seedling fresh weights, number of nodules and number of leaves after the 21 days of application.

Eisa (2016) reported that application of farmyard manure (100%) through seaweed extract resulted in maximum plant height, fresh and dry weight, number of leaves, bulb and fruit yield and in sweet fennel.

Lal *et al.* (2016) conducted an experiment on standardization of organic module for sustainable production of fenugreek (*Trigonella foenum-graecum* L.). They reported that organic module (M1), comprising of soil application of vermicompost @ 5 t ha^{-1} + foliar spray of 5% garlic extract @ 2.0 kg ha^{-1} + 2% neem oil @ 5 litre ha^{-1} + soil application of neem cake @ 150 kg ha^{-1} and *Trichoderma* @ 2.5 kg ha^{-1} , seed treatment with *Rhizobium* @ 100 ml kg^{-1} seed, PSB @ 100 ml kg^{-1} seed and *Trichoderma* @ 10 g kg^{-1} seed exhibited earliest seed germination and maximum plant height, number of branches, number of pods, number of seeds and highest grain yield.

Seema *et al.* (2016) studied the response of fenugreek (*Trigonella foenum-graecum* L.) to irrigation scheduling at vegetative, reproductive phases and organic manures under middle Gujarat conditions. Results revealed significantly higher grain yield (1831 kg ha^{-1}) and straw yield (2712 kg ha^{-1}) were recorded by the application of FYM 5 t ha^{-1} + Castor cake 1 t ha^{-1} .

Tagad *et al.* (2016) found increased vegetative growth in terms of plant height, number of branches per plant and leaf area due to different organic sources of nutrients and *Rhizobium* with Phosphate solubilizing bacteria as seed treatment. They also opined that combination of FYM + *Rhizobium* and Phosphate solubilizing bacteria as seed treatment with 25 g kg⁻¹ seed was found superior for increasing yield of fenugreek.

Ahmad *et al.* (2017) studied the effect of organic fertilizers on growth and yield of coriander and reported that organic fertilizer significantly affected all the studied attributes. The highest number of leaves branch⁻¹, maximum leaf area and minimum number of days taken to harvest were recorded in plants received poultry manure. The least number of days taken by the plant to germination was recorded from plot where compost was applied.

El-Sayed *et al.* (2017) revealed that combined application of 100% organic fertilizer with biofertilizer in dill cv. Balady, recorded the highest number of umbels per plant, number of umbellate per umbel and umbel diameter. Meanwhile, 100% organic fertilizer treatment was the best treatment for fruit weight, fruit yield and essential oil yield.

Godara *et al.* (2017) conducted an experiment on yield and economics of fenugreek (*Trigonella foenum-graecum* L.) as influenced by fertility levels, biofertilizers and brassinosteroid. They reported that integration of 80% RDF with dual inoculation of seed with *Rhizobium* + Phosphate solubilizing bacteria and supplemented with foliar spray of brassinosteroid @ 0.5 ppm at 50 and 70 DAS was better treatment for obtaining higher yield.

Mukesh *et al.* (2017) found that neem cake was found most effective to control the Fusarium wilt disease up to 58.95 per cent under field condition with maximum seed yield (790.50 kg ha⁻¹) in coriander.

Khoramivafa *et al.* (2018) studied the quantity and quality of dill essential oil as influenced by organic fertilizers and revealed that the combination of 20 t ha⁻¹ of cow manure and 7 t ha⁻¹ of vermicompost produced the maximum essential oil yield.

Kumar and George (2018) reported that drenching of pepper vines with AMC @ 20 g l⁻¹ thrice in a year performed significantly better in terms of reduction in leaf yellowing, collar infection incidence, wilting of vines and dry yield of 4.64 q ha⁻¹ which was higher than the other practices. The benefit cost ratio of 3.56 was higher than other practices.

Lunagariya *et al.* (2018) observed that among the solid organics, application of NADEP compost @ 5 t ha⁻¹ recorded significantly maximum plant height, number of branches plant⁻¹, green biomass, number of pods plant⁻¹, number of seeds pod⁻¹, test weight, protein content in seeds, seed and straw yield and was found statistically at par with application of vermicompost @ 2.5 t ha⁻¹.

Malav *et al.* (2018) conducted an experiment on effect of different organic sources on fenugreek (*Trigonella foenum-graecum* L.) under organic farming module. They reported that integrated application of various organic sources of nitrogen (50% RDN through castor cake + *Rhizobium* + PSB) recorded significantly higher seed and straw yield of fenugreek as compared to their individual application.

Meena *et al.* (2018) noticed that maximum plant height, number of primary & secondary branches, number of umbels plant⁻¹, number of seeds umbel⁻¹, number of seeds umbellate⁻¹, test weight (g), straw yield, umbellate umbel⁻¹, seed & biological yield (q ha⁻¹) were recorded in the treatment of (Soil solarisation - 30 days + Bio control agent + Neem cake) in cumin.

Murali *et al.* (2018) conducted an experiment on effect of different levels of organic manure on the growth and yield of mustard (*Brassica juncea* L.) under jatropha (*Jatropha circus* L.) based agroforestry system. They found that application of 50% FYM + 50% vermicompost recorded maximum plant height, number of branches, dry weight at 80 DAS and yield attributes *viz.*, number of siliqua plant⁻¹, number of seeds siliqua⁻¹, test weight, seed yield and stalk yield.

Raiyani *et al.* (2018) reported that significantly maximum values of growth parameters *viz.*, plant height, number of branches per plant, number and dry weight of root nodules, dry matter production, crop growth rate and yield

attributes *viz.*, number and length of pods per plant, number of seed per pod, seed yield (1,712 kg ha⁻¹) and straw yield (2,814 kg ha⁻¹) were recorded under the treatment of FYM 4 t ha⁻¹ + *Rhizobium* (seed inoculation) + Phosphate solubilizing bacteria + KSB (potassium solubilizing bacteria) (soil application) in fenugreek.

Rakesh *et al.* (2019) studied the effect of organic nutrient management in fenugreek (*Trigonella foenum graecum* L.) and they reported that among the different nutrient management practices, significantly higher plant growth parameters were recorded under the treatment of T₃ (Vermicompost @ 1.0 t ha⁻¹) and the same treatment also secured highest grain yield (2245 kg ha⁻¹) and straw yield (4572 kg ha⁻¹) as compared to other treatments.

2.2 EFFECT OF ORGANIC MANURES AND BIOFERTILIZERS ON QUALITY PARAMETERS

Naidu *et al.* (2010) concluded that application of FYM @ 2.8 t ha⁻¹ + poultry manure @ 3.5 t ha⁻¹ was found promising to obtain improved quality of fenugreek.

Ahmed *et al.* (2012) studied the influence of organic and biofertilizer on growth and yield of two fenugreek cultivars grown in sandy soil. They observed that fertilization with FYM 4m³ fed⁻¹. + *Azotobacter* + Yeast resulted the highest percentage of carbohydrate, protein and oil content of seed.

Aishwath *et al.* (2012) observed the effect of Phosphate solubilizing bacteria, *Azotobacter* and their combination on carotenoids and protein content in coriander. They found that carotenoids content at 60 DAS was more with Phosphate solubilizing bacteria inoculation and protein content in straw was enhanced with individual and combined use of inoculants.

Lal *et al.* (2012) revealed that soil application of vermicompost, *Trichoderma* and neem cake as well as seed treatment of *Azotobacter*, Phosphate solubilizing bacteria and *Trichoderma* with the foliar spray of garlic extract and

neem oil recorded highest chlorophyll content in leaves at 60 and 90 DAS as well as grain colour, aroma and essential oil content in coriander.

Naimuddin *et al.* (2014) studied the response of *Trigonella foenum-graecum* to organic manures and *Rhizobium* inoculation in a Typic Haplustept and reported that application of FYM and *Rhizobium* inoculation recorded the highest harvest index and protein content.

Anitha *et al.* (2015) evaluated the quality aspects of fenugreek seeds under different combinations of manures and fertilizers application. They found that protein content (9.36 mg 100 g⁻¹) was maximum in the combination of 50 per cent inorganic fertilizers and 50 per cent organic manures (*viz.*, poultry manure, vermicompost, neem cake, FYM) and biofertilizers inoculation.

Tagad *et al.* (2016) concluded that the qualitative parameters *viz.*, protein content (26.35%) and fibre content (65.02%) were superior in the combined application of FYM + *Rhizobium* and Phosphate solubilizing bacteria seed treatment in fenugreek.

Khoramivafa *et al.* (2018) conducted an experiment on quantity and quality of dill essential oil as influenced by organic fertilizers and reported that maximum value of carvone was obtained by the application of 20 t ha⁻¹ of manure and 15 t ha⁻¹ of vermicompost and compost tea in form of soil application.

2.3 EFFECT OF ORGANIC MANURES AND BIOFERTILIZERS ON SOIL AND PLANT NUTRIENT STATUS

Tiwari *et al.* (1999) noticed that seed inoculation with *Azotobacter* and *Azospirillum* significantly enhanced N uptake over untreated control in fenugreek. This is due to more nitrogen fixation of the bacteria resulting in better utilization of all the nutrients by the plants thus, resulting in more total uptake of nitrogen.

Deora and Jitendra Singh (2004) observed that in fenugreek application of vermicompost @ 4.0 t ha⁻¹ significantly increased nitrogen content in seed and phosphorus content in both seed and straw.

Kumar *et al.* (2009) reported that single as well as combined inoculation of *Rhizobium* + phosphate solubilizing bacteria recorded the highest N and P content in seed and straw in fenugreek.

Kumawat and Yadav (2009) reported that graded levels of FYM at ascending doses increased the uptake of nutrients significantly. The application of 10 t FYM per ha increased N, P, K, Ca and Na uptake by seed to the extent of 57.9, 106.7, 81.5, 45.3 and 29.0 per cent respectively as compared to control in fenugreek. The increase in N, P, K, Ca and Na uptake by straw with 10 t ha⁻¹ was observed to be 71.9, 147.2, 71.0, 64.1 and 31.2 per cent respectively over control.

Patel *et al.* (2014) studied the effect of different organic manures and biofertilizers on yield, nutrient uptake and economics of fenugreek (*Trigonella foenum-graecum* L.) under organic farming. Results revealed that conjunctive use of 50 per cent RDN through castor cake + *Rhizobium* and Phosphate solubilizing bacteria, remarkably improved soil fertility compared to RDF through inorganic fertilizers and sole application of either organic manures or biofertilizers.

Seema *et al.* (2016) studies conducted by response of fenugreek (*Trigonella foenum-graecum* L.) to irrigation scheduling at vegetative, reproductive phases and organic manures under middle Gujarat conditions. Results revealed that significantly higher grain yield (1831 kg ha⁻¹) and straw yield (2712 kg ha⁻¹) were recorded by the application of FYM 5 t ha⁻¹ + Castor cake 1 t ha⁻¹.

2.4 EFFECT OF ORGANIC MANURES AND BIOFERTILIZERS ON BENEFIT : COST RATIO

Choudhary (1999) conducted an experiment on response of fenugreek to N, P and *Rhizobium* inoculation and reported that *Rhizobium* inoculations resulted in the highest net returns (₹ 15,407 ha⁻¹) with best benefit cost (1.63) over other treatments.

Kumawat *et al.* (2003) revealed that seed inoculation with *Rhizobium* culture significantly increased all the growth and yield attributes and seed, straw and biological yields and net return over uninoculated control in fenugreek plant.

Patel *et al.* (2014) studied the nitrogen management in fenugreek under organic farming and revealed that conjunctive use of 50 per cent RDN through castor cake + *Rhizobium* and PSB seed as inoculation recorded maximum net returns and benefit: cost ratio in fenugreek.

Verma *et al.* (2014) conducted an experiment on effect of vermicompost and sulphur on growth, yield and nutrient uptake of fenugreek and reported that application of vermicompost upto 4 t ha⁻¹ significantly increased the net returns by 12.60 per cent over control.

Kumar and George (2018) reported that drenching of pepper vines with AMC @ 20 g l⁻¹ thrice in a year performed significantly better in terms of benefit cost ratio of 3.56 was higher than other practices.

Lunagariya *et al.* (2018) reported that combined application of NADAP compost @ 5 t ha⁻¹ and enriched banana pseudostem sap @ 5 L ha⁻¹ resulted the maximum net profit of ₹ 72746 ha⁻¹ with BCR of 2.28 followed by treatment combination of vermicompost @ 2.5 t ha⁻¹ and enriched banana pseudostem sap @ 5 L ha⁻¹ with net profit of ₹ 70597 ha⁻¹ and BCR of 2.27 in fenugreek.

Chapter IV

RESULTS AND DISCUSSION

The present investigation “**Efficacy of different organic manures and biofertilizers on kasuri methi (*Trigonella corniculata* L.) var. Pusa Kasuri under Telangana conditions**” was carried out during the *rabi* season of the year 2019-20 at the College of Horticulture, Rajendranagar, Hyderabad. The data collected during the study were statistically analyzed and the results obtained are discussed in this chapter under the following heads.

4.1 Growth parameters.

4.2 Yield parameters.

4.3 Quality parameters.

4.4 Soil and plant nutrient status.

4.5 Economic analysis.

4.1 Growth parameters.

4.1.1 Plant height (cm)

The data pertaining to plant height at 30, 60, 90 days after sowing and at harvesting stage as influenced by the treatments is presented in the table 4.1.1 and in the fig. 4.1.1.

AT 30 DAS

All treatments showed non significant differences with respect to plant height at this stage.

AT 60 DAS

Significant differences were observed due to treatments in plant height at 60 DAS. Significantly highest plant height was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN

through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) (23.71 cm), while it was significantly lowest in T₁₁ – Control (15.37 cm).

AT 90 DAS

There was significant difference observed among the treatments with respect to plant height at 90 DAS. Among the treatments, T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded significantly maximum value (39.73 cm), whereas T₁₁ - Control recorded significantly minimum value (30.40 cm).

AT HARVEST STAGE

All treatments showed significant difference with respect to plant height at harvest stage. Among the treatments, higher plant height of (42.07 cm) was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) at harvesting stage and it was non significant with T₁ treatment (39.84 cm), while T₁₁ - Control recorded significantly lowest plant height (32.17 cm).

In the present study, maximum plant height was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) which might be due to optimum dosage and beneficiary effect of organic manures and biofertilizers. The growth promoting effect of FYM as a source of plant nutrients and humus, improves physiological condition of the soil in terms of good aeration and proliferation of microbial activity (Joy *et al.* 2005). Similar observation was also reported by Khiriya *et al.* (2001), Kumawat *et al.* (2003), Raiyani *et al.* (2018) and Rakesh *et al.* (2019) in fenugreek and Agarwal *et al.* (2016) in coriander.

4.1.2 Number of branches per plant

Number of branches per plant at 30, 60, 90 days after sowing and at harvest stage as affected by organic manures and biofertilizers is presented in the table 4.1.2.

AT 30 DAS

Significant difference was observed due to treatments on this parameter at 30 DAS. Among the treatments, T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded more number of branches per plant (3.97) and was *on par* with T₁ (3.67), T₃ (3.6), T₂ (3.53), T₄ (3.4), T₆ (3.3), T₅ (3.2), T₇ (3.07), T₉ (2.97) treatments, whereas T₁₁ – Control recorded significantly lowest value (1.47).

AT 60 DAS

All treatments had significant difference on number of branches per plant at 60 DAS. Maximum number of branches (14.21) was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) which was significantly superior to other treatments, while it was significantly minimum value was recorded in T₁₁ - Control (8.9).

AT 90 DAS

There was significant difference observed due to treatments on this parameter at this stage also. Among the treatments, T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded more number of branches per plant (23.15) which was comparable with T₁ (21.47), T₃ (21.32), T₂ (21.15) treatments, whereas T₁₁ - Control recorded significantly minimum value (16.89).

AT HARVEST STAGE

Among the treatments, significant difference was observed on this parameter at this stage. More number of branches per plant (25.02) were recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) and it was non-significant with T₁ (23.58) treatment, while T₁₁ – Control recorded significantly less value (18.64).

The data enunciated on number of branches per plant at 30, 60, 90 DAS and at harvest stage revealed that, among the treatments T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded the highest value which was due to the application of organic manures and biofertilizer which led to continuous and prolonged availability of the nutrients, helped in breaking of apical dominance and produced more number of branches per plant. These results are in agreement with the findings of Raiyani *et al.* (2018) and Rakesh *et al.* (2019) in fenugreek.

4.1.3 Plant spread (cm) (North - South)

The results related to plant spread at 30, 60, 90 days after sowing and at harvest stage as influenced by the treatments is presented in the table 4.1.3 and the fig. 4.1.2.

AT 30 DAS

Non significant differences were observed due to treatments on plant spread in North – South direction.

AT 60 DAS

All treatments differed significantly on this parameter at this stage. Among all the treatments, T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded significantly maximum plant spread (North - South) (21.15 cm), whereas, significantly minimum value was recorded in T₁₁ - Control (14.78 cm).

AT 90 DAS

There was significant difference observed among the treatments on the plant spread (North - South). Significantly maximum value (27.13 cm) was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem

cake (1 t ha^{-1}) + 50% RDN through Vermicompost (2 t ha^{-1}) + AMC (7.5 lit ha^{-1}), while T_{11} - Control recorded significantly minimum value (19.81 cm).

AT HARVEST STAGE

Significant difference was observed due to treatments on this parameter (North - South) at harvest stage. Significantly maximum plant spread (29.82 cm) was registered in T_{10} - 50% RDN through FYM (8 t ha^{-1}) + 50% RDN through Neem cake (1 t ha^{-1}) + 50% RDN through Vermicompost (2 t ha^{-1}) + AMC (7.5 lit ha^{-1}), whereas T_{11} - Control recorded significantly lowest value (20.93 cm).

4.1.4 Plant spread (cm) (East - West)

The data recorded on plant spread (cm) (East - West) at 30, 60, 90 days after sowing and at harvest stage is presented in the table 4.1.4.

AT 30 DAS

All treatments showed non significant differences with respect to plant spread (cm) (East - West) at 30 DAS.

AT 60 DAS

There was significant difference observed among the treatments on plant spread (cm) (East - West) at 60 DAS. Significantly maximum value was recorded in T_{10} - 50% RDN through FYM (8 t ha^{-1}) + 50% RDN through Neem cake (1 t ha^{-1}) + 50% RDN through Vermicompost (2 t ha^{-1}) + AMC (7.5 lit ha^{-1}), (23.17 cm), while significantly minimum value was recorded in T_{11} - Control (16.89 cm).

AT 90 DAS

At 90 DAS, maximum value (28.33 cm) was recorded in T_{10} - 50% RDN through FYM (8 t ha^{-1}) + 50% RDN through Neem cake (1 t ha^{-1}) + 50% RDN through Vermicompost (2 t ha^{-1}) + AMC (7.5 lit ha^{-1}), which was on par with T_1 treatment (25.92 cm), whereas significantly minimum value (20.84 cm) was recorded in T_{11} - Control.

AT HARVEST STAGE

All treatments differ significantly on plant spread (cm) (East - West) at harvest stage. Significantly maximum value (31.20 cm) was registered in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹), while significantly minimum value was recorded in T₁₁ - Control (22.75 cm).

The highest plant spread (cm) (North - South) and (East - West) at 30, 60, 90 days after sowing and harvest stage was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹), might be due to the same treatment registered maximum plant height and more number of branches per plant as compared to rest of the treatments. The results are similar with the findings of Khiriya *et al.* (2001), Aiyathan and Salairajan (2008) in fenugreek and Naveen (2010) in kasuri methi.

4.2 Yield parameters.

4.2.1 Fresh herb yield per plant (g)

Table 4.2.1 and the fig. 4.2.1 represents that, among all the treatments, significantly higher fresh herb yield per plant was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) (24.63 g), whereas significantly lower value was recorded in T₁₁ - Control (9.89 g).

The highest fresh herb yield per plant was registered in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) which might be due to the same treatment recorded better vegetative growth in terms of plant height, number of branches per plant and wider plant spread over other treatments. Moreover it was due to the application of optimum and balanced nutrients through organic sources and biofertilizers, promoted better photosynthetic

activity that resulted in increased carbohydrate synthesis. Similar results were also reported by Mehta *et al.* (2010) and Rakesh *et al.* (2019) in fenugreek.

4.2.2 Fresh herb yield per hectare (kg)

Effect of treatments on fresh herb yield per hectare is presented in the table 4.2.1.

All treatments differed significantly on this parameter. Significantly maximum value (8090.53 kg) was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹), while it was significantly minimum in T₁₁ - Control (2164.31 kg).

Maximum fresh herb yield per hectare recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) was due to the same treatment registered higher fresh herb yield per plant over the other treatments. Similar results were also reported by Mehta *et al.* (2010) and Rakesh *et al.* (2019) in fenugreek.

4.2.3 Dry herb yield per plant (g)

The data on dry herb yield per plant as affected by the treatments is presented in the table 4.2.2.

Significantly maximum value (5.78 g) was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹), while it was significantly minimum in T₁₁ - Control (2.83 g).

The highest dry herb yield per plant was registered in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) might be due to the same treatment recorded maximum fresh herb yield per plant as compared to the rest of the treatments. Similar results were also reported by Rakesh *et al.* (2019) in fenugreek.

4.2.4 Dry herb yield per hectare (kg)

Dry herb yield per hectare as influenced by the treatments is presented in the table 4.2.2.

There was significant difference observed among the treatments with respect to dry herb yield per hectare. Significantly maximum value (1615.69 kg) was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹), while it was significantly minimum in T₁₁ - Control (559.18 kg).

Maximum dry herb yield per hectare was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) which was due to the same treatment registered higher dry herb yield per plant over other treatments. The present investigation was in consistent with other reports of Mehta *et al.* (2010) in fenugreek, Rakesh *et al.* (2019) in fenugreek.

4.2.5 Days taken to first flowering

The data recorded on days taken to first flowering is presented in the table 4.2.3 and the fig.4.2.2.

All treatments showed non significant differences with respect to days taken to first flowering.

4.2.6 Days taken to 50 per cent flowering

The results related days taken to 50 per cent flowering is presented in the table 4.2.3 and in the fig.4.2.2 (Plate 2).

No significant differences were observed among the treatments.

4.2.7 Number of pods per plant

The data pertaining to number of pods per plant as affected by the treatments is presented in the table 4.2.4.

All treatments differed significantly on this parameter. Significantly maximum value (634.56) was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹), while significantly minimum value was registered in T₁₁ – Control (286.3).

The reason for the highest number of pods recorded in T₁₀ might be due to the application of balanced nutrition through different organic sources as well as biofertilizer viz., AMC, resulted in increased vegetative growth and synthesis of relatively more amount of food materials and photosynthates were translocated and accumulated in the reproductive parts, led to maximum number of pods per plant. The results of the present study are comparable with that of Naimuddin *et al.* (2014) in fenugreek.

4.2.8 Length of pod (cm)

The data recorded on length of pod as influenced by the treatments is presented in the table 4.2.4.

Among the treatments, higher value (2.02 cm) was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) and was comparable with T₁ treatment (1.9 cm), while T₁₁ – Control (1.4 cm) recorded significantly the minimum value.

The highest pod length was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) might be due to the same treatment registered maximum leaf area resulted in better photosynthesis, led to more accumulation of photosynthates in pod. This result was in conformity with the findings of Yadav and Kumawat (2003), Purbey and Sen (2005) and Godara *et al.* (2012) in fenugreek.

4.2.9 Number of seeds per pod

Number of seeds per pod as affected by the organic manures and biofertilizers is presented in the table 4.2.4.

There was significant difference observed among the treatments on this parameter. Maximum value (6.03) was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) and was comparable with T₁ (5.88) and T₃ (5.85) treatments, while T₁₁ – Control recorded significantly minimum value (4.25).

4.2.10 Seed yield per plant (g)

Table 4.2.5 represents that, all treatments differed significantly on seed yield per plant. Significantly maximum value (1.61 g) was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹), whereas significantly minimum value was recorded in T₁₁ – Control (0.74 g) (Plate 3).

The maximum seed yield per plant was recorded is T₁₀ was due to the same treatment registered more number of pods per plant and maximum pod length as compared to rest of the treatments. These results are in accordance with the findings of Naimuddin *et al.* (2014), Raiyani *et al.* (2018), Rakesh *et al.* (2019) in fenugreek and Kumar *et al.* (2015) in coriander

4.2.11 Seed yield per hectare (kg)

Effect of treatments on seed yield per hectare is presented in the table 4.2.5.

There was significant difference observed due to treatments on seed yield per hectare. Among the treatments, T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded significantly maximum value (482.41 kg), while T₁₁ – Control recorded significantly minimum value (107.97 kg).

The highest seed yield per hectare was registered in T₁₀ might be due to the same treatment registered maximum seed yield per plant over other treatments. Moreover it was due to the application of optimum quantity of different nutrient sources improved soil physical, chemical and biological properties resulted in higher fertilizer use efficiency, ultimately led to more seed yield. Similar results were also reported by Rakesh *et al.* (2019).

4.2.12 Test weight (1000 seed weight) (g)

All treatments showed non significant differences with respect to test weight (1000 seed weight).

4.3 Quality parameters.

4.3.1 Crude protein content in herb and seed (%)

Effect of treatments on crude protein content of herb and seed is illustrated in the table 4.3.1.

All treatments had significant influence on crude protein content in herb. Among the treatments, T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded significantly maximum value (9.57%), while T₁₁ - Control recorded significantly minimum value (5.79%).

Similarly maximum (19.53%) crude protein content in seed was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded and was *on par* with T₁ (18.79%), T₃ (18.68%), T₂ (18.48%), T₄ (18.21%), T₆ (18.06%), T₅ (17.94%) and T₇ (17.7%) treatments, while it was significantly minimum in T₁₁ - Control (15.18%).

The maximum crude protein content in herb and seed was recorded in T₁₀ might be due to the application of organic manures viz., FYM and vermicompost helped in availability of nitrogen element throughout the cropping period, resulted in better uptake and assimilation of crude protein in herb and seed. The

present results are inconsistent with the other reports of Naidu *et al.* (2010) and Naimuddin *et al.* (2014) in fenugreek.

4.3.2 Chlorophyll content in leaves at 60 DAS (mg 100 mg⁻¹ of tissue)

The data pertaining to chlorophyll content in leaves as affected by the treatments is presented in the table 4.3.2 and the fig. 4.3.1.

Chlorophyll ‘a’ content at 60 DAS (mg 100 mg⁻¹ of tissue)

All treatments differed significantly in Chlorophyll ‘a’ content at 60 DAS. Among all the treatments, T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded significantly maximum value (16.85 mg 100 mg⁻¹ of tissue), while it was significantly minimum in T₁₁ – Control (11.73 mg 100 mg⁻¹ of tissue).

Chlorophyll ‘b’ content at 60 DAS (mg 100 mg⁻¹ of tissue)

Among all treatments, maximum value (5.84 mg 100 mg⁻¹ of tissue) was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) and was comparable with T₁ (5.61 mg 100 mg⁻¹ of tissue) treatment, while it was significantly minimum in T₁₁ - Control (3.47 mg 100 mg⁻¹ of tissue).

Total chlorophyll content at 60 DAS (mg 100 mg⁻¹ of tissue)

Significant difference was observed among the treatments on this parameter. Among the treatments, T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded significantly higher value (22.69 mg 100 mg⁻¹ of tissue), while T₁₁ - Control recorded significantly minimum value (15.2 mg 100 mg⁻¹ of tissue).

The maximum chlorophyll “a”, “b”, and total content in leaves at 60 DAS was recorded in T₁₀ might be due to optimum availability of nutrients like nitrogen, which was supplied by organic manures and biofertilizers might be

attributed to enhance chlorophyll content in leaves. The results of the present study are comparable with the findings of Lal *et al.* (2012) in coriander and Rizvi *et al.* (2013) in fenugreek.

4.4 Soil and plant nutrient status.

The data on nutrient status *viz.*, available nitrogen, phosphorous and potassium in soil, after harvest of the crop and in herb, straw and seed are presented in the table 4.4.1 to 4.4.4.

4.4.1 Soil nutrient status before sowing and after harvest of the crop

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

The data pertaining to available nitrogen in soil as influenced by the treatments presented in the table 4.4.1 and in the fig. 4.4.1.

It was observed that initial nitrogen content in the soil was recorded as (205.8 kg ha^{-1}). All treatments differed significantly on this parameter. Among the treatments, T₁₀ - 50% RDN through FYM (8 t ha^{-1}) + 50% RDN through Neem cake (1 t ha^{-1}) + 50% RDN through Vermicompost (2 t ha^{-1}) + AMC (7.5 lit ha^{-1}) recorded significantly maximum value ($198.42 \text{ kg ha}^{-1}$), while it was significantly minimum in T₁₁ - Control ($112.85 \text{ kg ha}^{-1}$).

The maximum available nitrogen content in the soil after harvest of the crop was recorded in T₁₀ might be due to balanced and optimum quantities of organic sources like FYM, Vermicompost, Neem cake and bio fertilizers helped in providing the more nitrogen element to the soil.

4.4.1.2 Available Phosphorous (kg ha^{-1})

Table 4.4.1 and the fig. 4.4.1 represents that, the initial phosphorous content was recorded as (44.7 kg ha^{-1}). From the data it is clear that there was significant difference observed among the treatments. Significantly maximum available of phosphorous was recorded in T₁₀ - 50% RDN through FYM (8 t ha^{-1}) + 50% RDN through Neem cake (1 t ha^{-1}) + 50% RDN through Vermicompost (2

t ha⁻¹) + AMC (7.5 lit ha⁻¹) (49.22 kg ha⁻¹), while T₁₁ - Control treatment has registered significantly minimum value (27.91 kg ha⁻¹).

The data on available phosphorous content in the soil after harvest of the crop indicated that T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) registered the highest value which T₁₀ might be due to balanced and optimum quantities of organic sources like FYM, Vermicompost, Neem cake and bio fertilizers helped in providing the more phosphorous element to the soil.

4.4.1.3 Available Potassium (kg ha⁻¹)

The results related to available potassium as affected by the treatments is presented in the table 4.4.1 and the fig. 4.4.1.

With respect to the initial potassium content in the soil was recorded as (65.45 kg ha⁻¹). Among all treatments, T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded maximum value (170.80 kg ha⁻¹) and was *on par* with T₁ (168.91 kg ha⁻¹), T₃ (165.53 kg ha⁻¹), T₂ (161.02 kg ha⁻¹), T₄ (156.37 kg ha⁻¹) and T₆ (153.14 kg ha⁻¹) treatments, while T₁₁ - Control recorded significantly minimum value (122.03 kg ha⁻¹).

The data enunciated on available potassium content in the soil after harvest of the crop revealed that higher value was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) T₁₀ might be due to balanced and optimum quantities of organic sources like FYM, Vermicompost, Neem cake and bio fertilizers helped in providing the more potassium element to the soil. These studies are in line with the report of Rizvi *et al.* (2013) in fenugreek.

4.4.2 Nitrogen content in herb, straw and seed (%)

Effect of treatments on this parameter is presented in the table 4.4.2.

Among all the treatments, maximum nitrogen content in the herb was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) (1.43%) and was on par with T₁ (1.38 %) treatment, while significantly minimum value was recorded in T₁₁ - Control (0.83%).

It was observed that, T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded significantly highest nitrogen content in the straw (1.19%), while T₁₁ - Control recorded significantly lowest value (0.7%).

From the data it is clear that, maximum nitrogen content in the seed was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) (2.95%) and was on par with T₁ (2.81%), while it was significantly recorded minimum in T₁₁ - Control (2.16%).

4.4.3 Phosphorous content in herb, straw and seed (%)

The data on effect of treatments on phosphorous content in herb, straw and seed is presented in the table 4.4.3.

Significant difference was observed among the treatments with respect to phosphorous content in herb. Among all treatments, significantly maximum value (0.59%) was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹), whereas, significantly minimum value was recorded in T₁₁ - Control (0.22%).

It was observed that, T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded maximum phosphorous content in straw (0.39%) and was *on par* with T₁ (0.37%) and T₃ (0.36%) treatments, while T₁₁ - Control recorded significantly minimum value (0.13%).

Similarly, the highest phosphorous content in seed was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) (0.58%) and was comparable with T₁ (0.56%) and T₃ (0.55%) treatments, whereas significantly lowest in T₁₁ - Control (0.21%).

4.4.4 Potassium content in herb, straw and seed (%)

Effect of treatments on this parameter is presented in the table 4.4.4 and fig. 4.4.2.

Among all the treatments, maximum value (0.59%) was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) and was comparable with T₁ (0.57%) treatment, while significantly minimum value was recorded in T₁₁ - Control (0.27%).

It was observed that, T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded maximum potassium content in straw (0.79%), which was *on par* with T₁ (0.76%) and T₃ (0.75%) treatments, while T₁₁ - Control recorded significantly lowest value (0.34%).

Similarly, more potassium content in seed was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) (0.38%) and was non-significant with T₁ (0.36%) treatment, while T₁₁ - Control treatment recorded significantly minimum value (0.14%).

Maximum nitrogen, phosphorous and potassium content in herb, straw and seed was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) which might be due to the organic manures viz., FYM, Neem cake and vermicompost supplied the nutrients throughout the crop period. Moreover application of biofertilizers increased the major and micronutrients availability in the rhizosphere as a greater expansion, resulted in more uptake of

nutrients by the plants. The application of nutrients through FYM definitely increased the nutrient content in the crop and also improved the physico-chemical properties of the soil. Similar results were also reported by Kumawat and Yadav (2009) and Rizvi *et al.* (2013) in fenugreek.

4.5 Economic analysis.

The data recorded on economic analysis as influenced by the treatments is presented in the table 4.5.

Among the treatments, T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded the highest gross return (₹ 238996.2), net returns (₹ 160416.2) with benefit cost ratio (2.04: 1) followed by T₁ - 100% RDN through FYM (16 t ha⁻¹) + AMC (7.5 lit ha⁻¹) with gross returns (₹ 191403.0), net return (₹ 125823.0) with benefit cost ratio (1.91: 1), while T₁₁ - Control recorded the lowest gross returns (₹ 60561.4), net returns (₹ 29681.4) with benefit cost ratio (0.96: 1).

It is evident from the data that, maximum gross returns was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) which might be due to T₁₀ treatment recorded higher herb yield as well as seed yield per hectare as compared to other treatment combinations. The findings are in line with the reports of Patel *et al.* (2014), Verma *et al.* (2014) and Lunagariya *et al.* (2018) in fenugreek.

Table 4.1.1 Effect of organic manures and biofertilizers on plant height (cm) at different growth stages of kasuri methi var. Pusa Kasuri

Treatments (T)	Plant height (cm)			
	30 DAS	60 DAS	90 DAS	At harvest
T ₁ : 100% RDN through FYM (16 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	4.96	21.62 ^b	37.89 ^b	39.84 ^{ab}
T ₂ : 100% RDN through Neem cake (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	4.68	20.32 ^{cd}	37.42 ^{bc}	39.43 ^b
T ₃ : 100% RDN through Vermicompost (4 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	4.86	20.94 ^{bc}	37.66 ^{bc}	39.55 ^b
T ₄ : 75% RDN through FYM (12 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	4.49	19.87 ^d	37.23 ^{bc}	39.31 ^b
T ₅ : 75% RDN through Neem cake (1.5 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	4.25	19.55 ^{de}	36.97 ^{bc}	38.88 ^b
T ₆ : 75% RDN through Vermicompost (3 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	4.34	19.71 ^{de}	37.07 ^{bc}	39.13 ^b
T ₇ : 50% RDN through FYM (8 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	4.17	18.70 ^{ef}	36.57 ^{bc}	38.52 ^b
T ₈ : 50% RDN through Neem cake (1 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	4.05	17.97 ^f	36.03 ^c	38.19 ^b
T ₉ : 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	4.09	18.33 ^f	36.32 ^{bc}	38.36 ^b
T ₁₀ : 50% RDN through FYM (8 t ha ⁻¹) + 50% RDN through Neem cake (1 t ha ⁻¹) + 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	5.11	23.71 ^a	39.73 ^a	42.07 ^a
T ₁₁ : Control (without any application)	2.61	15.37 ^g	30.40 ^d	32.17 ^c
SEm ±	0.45	0.35	0.6	0.77
CD at 5%	NS	1.05	1.76	2.27

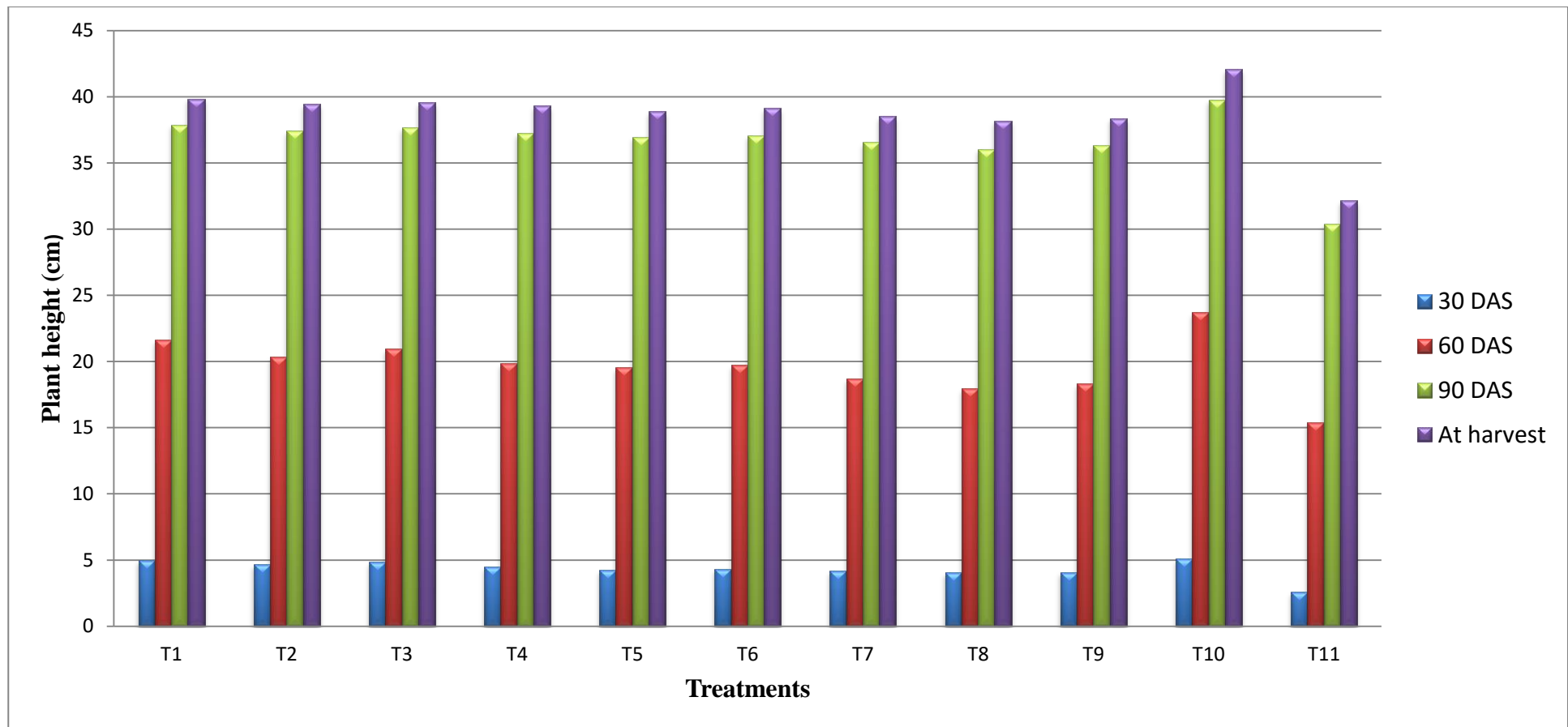


Fig.4.1.1 Effect of organic manures and biofertilizers on plant height (cm) at different growth stages of kasuri methi var. Pusa Kasuri

Table 4.1.2 Effect of organic manures and biofertilizers on number of branches per plant at different growth stages of kasuri methi var. Pusa Kasuri

Treatments (T)	Number of branches per plant			
	30 DAS	60 DAS	90 DAS	At harvest
T ₁ : 100% RDN through FYM (16 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	3.67 ^{ab}	12.69 ^b	21.47 ^{ab}	23.58 ^{ab}
T ₂ : 100% RDN through Neem cake (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	3.53 ^{ab}	12.30 ^{bc}	21.15 ^{abc}	23.01 ^{bcd}
T ₃ : 100% RDN through Vermicompost (4 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	3.60 ^{ab}	12.44 ^b	21.32 ^{abc}	23.23 ^{bc}
T ₄ : 75% RDN through FYM (12 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	3.40 ^{ab}	12.20 ^{bcd}	20.87 ^{bc}	22.51 ^{bcde}
T ₅ : 75% RDN through Neem cake (1.5 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	3.20 ^{ab}	11.90 ^{bcd}	20.06 ^{bc}	22.07 ^{bcde}
T ₆ : 75% RDN through Vermicompost (3 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	3.33 ^{ab}	12.03 ^{bcd}	20.48 ^{bc}	22.34 ^{bcde}
T ₇ : 50% RDN through FYM (8 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	3.07 ^{ab}	11.60 ^{bcd}	19.81 ^{bc}	21.77 ^{cde}
T ₈ : 50% RDN through Neem cake (1 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	2.80 ^b	11.15 ^d	19.29 ^c	21.05 ^e
T ₉ : 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	2.97 ^{ab}	11.29 ^{cd}	19.46 ^{bc}	21.34 ^{de}
T ₁₀ : 50% RDN through FYM (8 t ha ⁻¹) + 50% RDN through Neem cake (1 t ha ⁻¹) + 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	3.97 ^a	14.21 ^a	23.15 ^a	25.02 ^a
T ₁₁ : Control (without any application)	1.47 ^c	8.90 ^e	16.89 ^d	18.64 ^f
SEm ±	0.37	0.38	0.71	0.59
CD at 5%	1.08	1.11	2.09	1.73

Table 4.1.3 Effect of organic manures and biofertilizers on plant spread (cm) (North - South), at different growth stages of kasuri methi var. Pusa Kasuri

Treatments (T)	Plant spread (cm)			
	North – South			
	30 DAS	60 DAS	90 DAS	At harvest
T ₁ : 100% RDN through FYM (16 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	7.65	19.04 ^b	24.85 ^b	27.81 ^b
T ₂ : 100% RDN through Neem cake (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	7.20	18.40 ^{bcd}	24.12 ^{bcd}	27.04 ^{bc}
T ₃ : 100% RDN through Vermicompost (4 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	7.35	18.72 ^{bc}	24.49 ^{bc}	27.34 ^{bc}
T ₄ : 75% RDN through FYM (12 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	7.16	18.27 ^{bcd}	23.80 ^{bcd}	26.71 ^{bcd}
T ₅ : 75% RDN through Neem cake (1.5 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	6.95	18.04 ^{bcd}	23.19 ^{bcd}	26.09 ^{cde}
T ₆ : 75% RDN through Vermicompost (3 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	7.08	18.13 ^{bcd}	23.36 ^{bcd}	26.32 ^{bcd}
T ₇ : 50% RDN through FYM (8 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	6.79	17.77 ^{cde}	22.81 ^{bcd}	25.80 ^{cde}
T ₈ : 50% RDN through Neem cake (1 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	6.27	17.07 ^e	22.18 ^d	25.06 ^e
T ₉ : 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	6.67	17.40 ^{de}	22.53 ^{cd}	25.35 ^{de}
T ₁₀ : 50% RDN through FYM (8 t ha ⁻¹) + 50% RDN through Neem cake (1 t ha ⁻¹) + 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	8.83	21.15 ^a	27.13 ^a	29.82 ^a
T ₁₁ : Control (without any application)	4.33	14.78 ^f	19.81 ^e	20.93 ^f
SEm ±	0.76	0.4	0.74	0.54
CD at 5%	NS	1.17	2.18	1.6

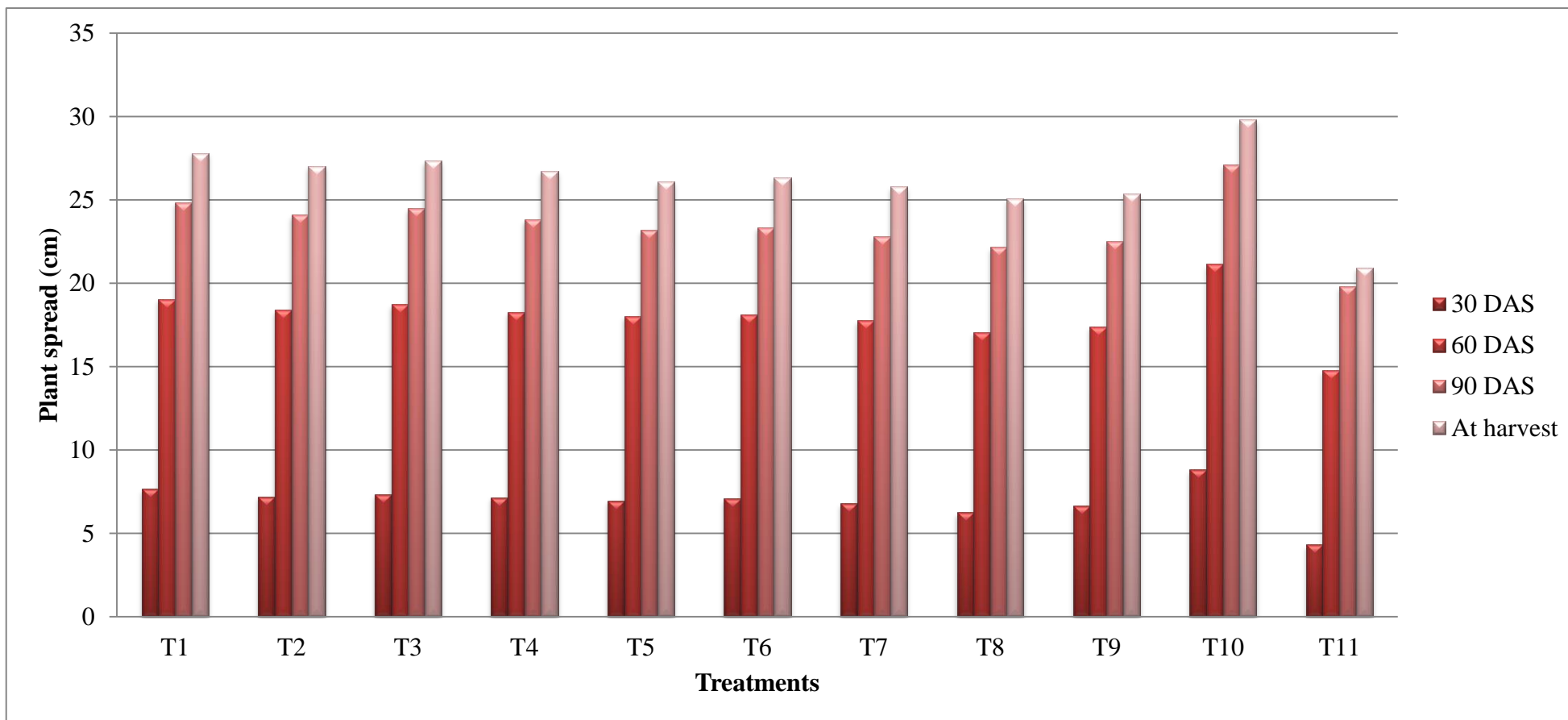


Fig.4.1.2 Effect of organic manures and biofertilizers on plant spread (cm) (North - South), at different growth stages of kasuri methi var. Pusa Kasuri

Table 4.1.4 Effect of organic manures and biofertilizers on plant spread (cm) (East - West), at different growth stages of kasuri methi var. Pusa Kasuri

Treatments (T)	Plant spread (cm)			
	East – West			
	30 DAS	60 DAS	90 DAS	At Harvest
T ₁ : 100% RDN through FYM (16 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	8.25	21.03 ^b	25.92 ^{ab}	28.20 ^b
T ₂ : 100% RDN through Neem cake (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	8.07	20.28 ^{bcd}	25.53 ^b	27.69 ^b
T ₃ : 100% RDN through Vermicompost (4 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	8.14	20.70 ^{bc}	25.76 ^b	27.85 ^b
T ₄ : 75% RDN through FYM (12 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	7.87	20.10 ^{bcd}	25.23 ^b	27.50 ^b
T ₅ : 75% RDN through Neem cake (1.5 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	7.58	19.78 ^{cd}	24.92 ^b	27.10 ^b
T ₆ : 75% RDN through Vermicompost (3 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	7.75	20.00 ^{bcd}	25.10 ^b	27.23 ^b
T ₇ : 50% RDN through FYM (8 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	7.40	19.50 ^d	24.55 ^b	26.76 ^b
T ₈ : 50% RDN through Neem cake (1 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	7.16	19.15 ^d	24.06 ^b	26.08 ^b
T ₉ : 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	7.27	19.27 ^d	24.37 ^b	26.43 ^b
T ₁₀ : 50% RDN through FYM (8 t ha ⁻¹) + 50% RDN through Neem cake (1 t ha ⁻¹) + 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	9.01	23.17 ^a	28.33 ^a	31.20 ^a
T ₁₁ : Control (without any application)	4.97	16.89 ^e	20.84 ^c	22.75 ^c
SEm ±	0.68	0.38	0.82	0.74
CD at 5%	NS	1.13	2.42	2.17

Table 4.2.1 Effect of organic manures and biofertilizers on fresh herb yield per plant and per hectare of kasuri methi var.**Pusa Kasuri**

Treatments (T)	Fresh herb yield (g plant⁻¹)	Fresh herb yield(kg ha⁻¹)
T ₁ : 100% RDN through FYM (16 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	21.97 ^b	6787.67 ^b
T ₂ : 100% RDN through Neem cake (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	20.76 ^c	6263.73 ^c
T ₃ : 100% RDN through Vermicompost (4 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	21.49 ^{bc}	6366.73 ^c
T ₄ : 75% RDN through FYM (12 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	18.94 ^d	5681.13 ^d
T ₅ : 75% RDN through Neem cake (1.5 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	18.05 ^{de}	5319.47 ^e
T ₆ : 75% RDN through Vermicompost (3 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	18.32 ^d	5407.73 ^e
T ₇ : 50% RDN through FYM (8 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	17.21 ^{ef}	4504.89 ^f
T ₈ : 50% RDN through Neem cake (1 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	16.85 ^f	4197.20 ^g
T ₉ : 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	17.04 ^{ef}	4236.13 ^g
T ₁₀ : 50% RDN through FYM (8 t ha ⁻¹) + 50% RDN through Neem cake (1 t ha ⁻¹) + 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	24.63 ^a	8090.53 ^a
T ₁₁ : Control (without any application)	9.89 ^g	2164.31 ^h
SEm ±	0.35	37.74
CD at 5%	1.04	111.32

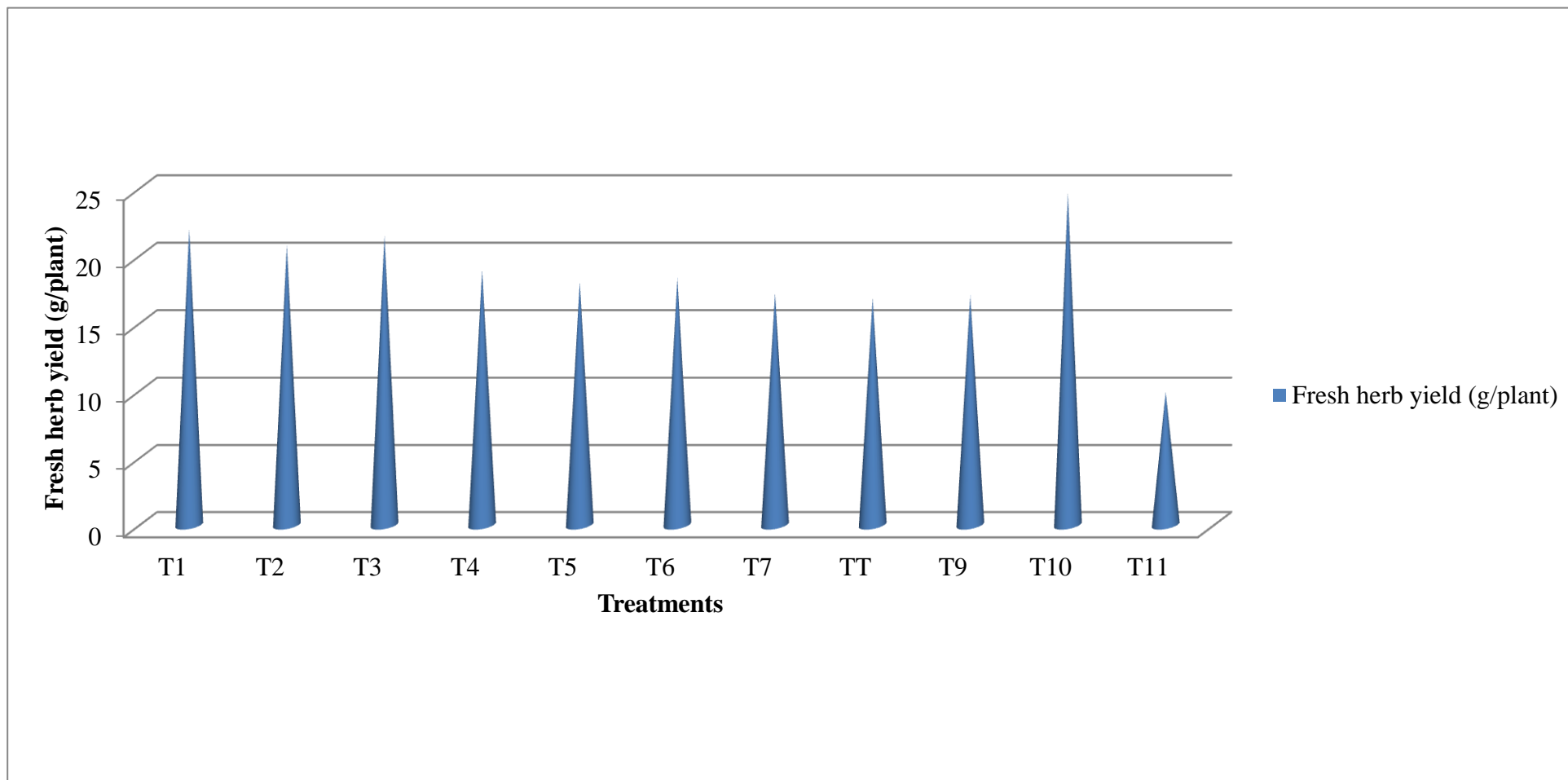


Fig.4.2.1 Effect of organic manures and biofertilizers on fresh herb yield per plant of kasuri methi var. Pusa Kasuri

Table 4.2.2 Effect of organic manures and biofertilizers on dry herb yield per plant and per hectare of kasuri methi var.

Pusa Kasuri

Treatments (T)	Dry herb yield (g plant⁻¹)	Dry herb yield (kg ha⁻¹)
T ₁ : 100% RDN through FYM (16 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	5.14 ^{bc}	1361.04 ^b
T ₂ : 100% RDN through Neem cake (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	4.95 ^{bcde}	1256.46 ^c
T ₃ : 100% RDN through Vermicompost (4 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	5.02 ^{bcd}	1283.25 ^{bc}
T ₄ : 75% RDN through FYM (12 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	4.66 ^{def}	1143.98 ^{de}
T ₅ : 75% RDN through Neem cake (1.5 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	4.37 ^{fg}	1049.99 ^f
T ₆ : 75% RDN through Vermicompost (3 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	4.53 ^{ef}	1090.59 ^{ef}
T ₇ : 50% RDN through FYM (8 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	4.07 ^{gh}	891.36 ^{gh}
T ₈ : 50% RDN through Neem cake (1 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	3.83 ^h	827.07 ^h
T ₉ : 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	3.93 ^h	856.76 ^h
T ₁₀ : 50% RDN through FYM (8 t ha ⁻¹) + 50% RDN through Neem cake (1 t ha ⁻¹) + 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	5.78 ^a	1615.69 ^a
T ₁₁ : Control (without any application)	2.83 ⁱ	559.18 ⁱ
SEm ±	0.14	30.09
CD at 5%	0.42	88.77

Table 4.2.3 Effect of organic manures and biofertilizers on days taken to 1st flowering and 50% flowering of kasuri methi var. Pusa Kasuri.

Treatments (T)	Days taken to 1st flowering	Days taken to 50 % flowering
T ₁ : 100% RDN through FYM (16 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	64.47	94.88
T ₂ : 100% RDN through Neem cake (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	64.05	94.08
T ₃ : 100% RDN through Vermicompost (4 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	64.36	94.59
T ₄ : 75% RDN through FYM (12 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	63.85	93.88
T ₅ : 75% RDN through Neem cake (1.5 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	63.23	93.03
T ₆ : 75% RDN through Vermicompost (3 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	63.40	93.48
T ₇ : 50% RDN through FYM (8 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	62.58	92.80
T ₈ : 50% RDN through Neem cake (1 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	62.13	92.13
T ₉ : 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	62.48	92.54
T ₁₀ : 50% RDN through FYM (8 t ha ⁻¹) + 50% RDN through Neem cake (1 t ha ⁻¹) + 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	64.87	95.55
T ₁₁ : Control (without any application)	61.43	91.30
SEm ±	1.32	1.12
CD at 5%	NS	NS

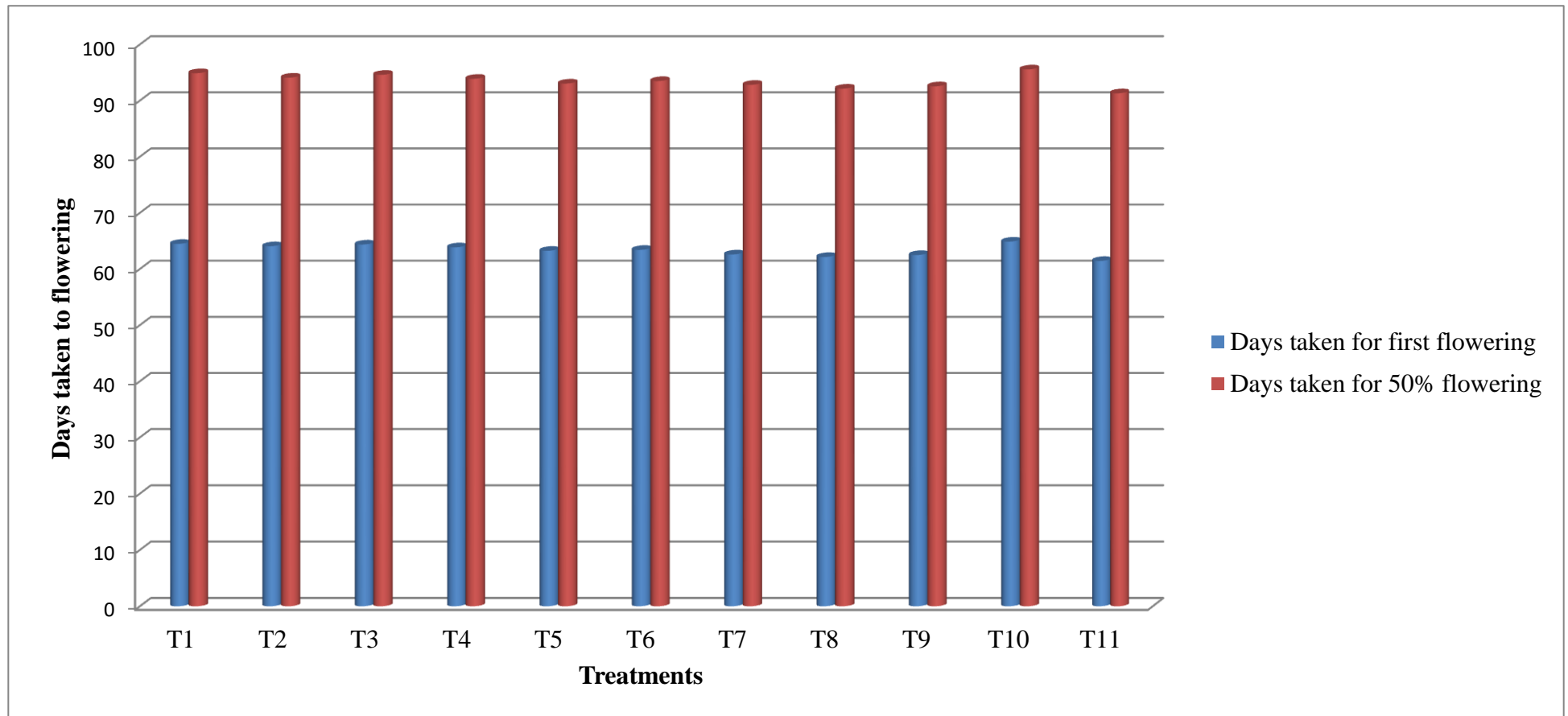


Fig.4.2.2 Effect of organic manures and biofertilizers on days taken to 1st flowering and 50 % flowering of kasuri methi var. Pusa Kasuri.

Table 4.2.4 Effect of organic manures and biofertilizers on number of pods plant⁻¹, pod length (cm) and number of seeds pod⁻¹ of kasuri methi var. Pusa Kasuri

Treatments (T)	No. of pods plant ⁻¹	Pod length (cm)	No. of seeds pod ⁻¹
T ₁ : 100% RDN through FYM (16 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	576.66 ^b	1.90 ^{ab}	5.88 ^{ab}
T ₂ : 100% RDN through Neem cake (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	532.39 ^c	1.80 ^{bcd}	5.78 ^{bc}
T ₃ : 100% RDN through Vermicompost (4 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	546.09 ^{bc}	1.84 ^{bc}	5.85 ^{ab}
T ₄ : 75% RDN through FYM (12 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	504.96 ^{cd}	1.75 ^{cde}	5.60 ^{cd}
T ₅ : 75% RDN through Neem cake (1.5 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	471.59 ^{de}	1.64 ^{efg}	5.42 ^{de}
T ₆ : 75% RDN through Vermicompost (3 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	487.03 ^d	1.70 ^{def}	5.53 ^d
T ₇ : 50% RDN through FYM (8 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	442.45 ^{ef}	1.57 ^{fgh}	5.30 ^{ef}
T ₈ : 50% RDN through Neem cake (1 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	402.27 ^f	1.48 ^{hi}	5.16 ^f
T ₉ : 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	413.99 ^f	1.55 ^{ghi}	5.25 ^{ef}
T ₁₀ : 50% RDN through FYM (8 t ha ⁻¹) + 50% RDN through Neem cake (1 t ha ⁻¹) + 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	634.56 ^a	2.02 ^a	6.03 ^a
T ₁₁ : Control (without any application)	286.30 ^g	1.40 ^j	4.25 ^g
SEm ±	14.53	0.05	0.07
CD at 5%	42.85	0.13	0.22

Table 4.2.5 Effect of organic manures and biofertilizers on seed yield per plant (g), per hectare (kg) and test weight (g) of kasuri methi var. Pusa Kasuri

Treatments (T)	Seed yield (g plant ⁻¹)	Seed yield (kg ha ⁻¹)	Test weight (g) (weight of 1000 seeds)
T ₁ : 100% RDN through FYM (16 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	1.45 ^b	347.81 ^b	1.55
T ₂ : 100% RDN through Neem cake (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	1.36 ^{bc}	310.73 ^{bcd}	1.50
T ₃ : 100% RDN through Vermicompost (4 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	1.39 ^{bc}	320.05 ^{bc}	1.53
T ₄ : 75% RDN through FYM (12 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	1.30 ^c	269.04 ^{de}	1.48
T ₅ : 75% RDN through Neem cake (1.5 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	1.17 ^{de}	233.20 ^{ef}	1.40
T ₆ : 75% RDN through Vermicompost (3 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	1.28 ^{cd}	246.63 ^{ef}	1.43
T ₇ : 50% RDN through FYM (8 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	1.15 ^e	215.49 ^f	1.37
T ₈ : 50% RDN through Neem cake (1 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	1.03 ^f	203.45 ^f	1.30
T ₉ : 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	1.08 ^{ef}	209.17 ^f	1.33
T ₁₀ : 50% RDN through FYM (8 t ha ⁻¹) + 50% RDN through Neem cake (1 t ha ⁻¹) + 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	1.61 ^a	482.41 ^a	1.63
T ₁₁ : Control (without any application)	0.74 ^g	107.97 ^g	1.20
SEm ±	0.04	17.08	0.09
CD at 5%	0.11	50.39	NS

Table 4.3.1 Effect of organic manures and biofertilizers on crude protein content in herb and seed (%) of kasuri methi var. Pusa Kasuri

Treatments (T)	Crude protein content in herb (%)	Crude protein content in seed (%)
T ₁ : 100% RDN through FYM (16 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	8.68 ^b	18.79 ^{ab}
T ₂ : 100% RDN through Neem cake (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	8.24 ^{bcd}	18.48 ^{ab}
T ₃ : 100% RDN through Vermicompost (4 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	8.39 ^{bc}	18.68 ^{ab}
T ₄ : 75% RDN through FYM (12 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	8.01 ^{bcde}	18.21 ^{ab}
T ₅ : 75% RDN through Neem cake (1.5 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	7.67 ^{def}	17.94 ^{ab}
T ₆ : 75% RDN through Vermicompost (3 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	7.90 ^{cde}	18.06 ^{ab}
T ₇ : 50% RDN through FYM (8 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	7.42 ^{efg}	17.70 ^{ab}
T ₈ : 50% RDN through Neem cake (1 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	7.05 ^g	17.17 ^b
T ₉ : 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	7.18 ^{fg}	17.43 ^b
T ₁₀ : 50% RDN through FYM (8 t ha ⁻¹) + 50% RDN through Neem cake (1 t ha ⁻¹) + 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	9.57 ^a	19.53 ^a
T ₁₁ : Control (without any application)	5.79 ^h	15.18 ^c
SEm ±	0.23	0.63
CD at 5%	0.67	1.87

Table 4.3.2 Effect organic manures and biofertilizers on chlorophyll contents (mg 100 mg⁻¹) at 60 DAS of kasuri methi var. Pusa Kasuri

Treatments (T)	Chlorophyll contents (mg 100 mg ⁻¹ of tissue at 60 DAS)		
	Chlorophyll 'a'	Chlorophyll 'b'	Total chlorophyll
T ₁ : 100% RDN through FYM (16 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	15.53 ^b	5.61 ^{ab}	21.14 ^b
T ₂ : 100% RDN through Neem cake (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	15.15 ^{bc}	5.09 ^{cd}	20.24 ^{cd}
T ₃ : 100% RDN through Vermicompost (4 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	15.31 ^{bc}	5.38 ^{bc}	20.69 ^{bc}
T ₄ : 75% RDN through FYM (12 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	14.91 ^{cd}	4.92 ^{cd}	19.83 ^{de}
T ₅ : 75% RDN through Neem cake (1.5 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	14.42 ^{def}	4.69 ^{de}	19.11 ^{fg}
T ₆ : 75% RDN through Vermicompost (3 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	14.71 ^{cde}	4.80 ^{de}	19.51 ^{ef}
T ₇ : 50% RDN through FYM (8 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	14.23 ^{ef}	4.47 ^{ef}	18.70 ^{gh}
T ₈ : 50% RDN through Neem cake (1 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	13.83 ^f	4.10 ^f	17.93 ⁱ
T ₉ : 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	14.03 ^f	4.23 ^f	18.26 ^{hi}
T ₁₀ : 50% RDN through FYM (8 t ha ⁻¹) + 50% RDN through Neem cake (1 t ha ⁻¹) + 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	16.85 ^a	5.84 ^a	22.69 ^a
T ₁₁ : Control (without any application)	11.73 ^g	3.47 ^g	15.20 ^j
SEm ±	0.2	0.14	0.2
CD at 5%	0.6	0.42	0.58

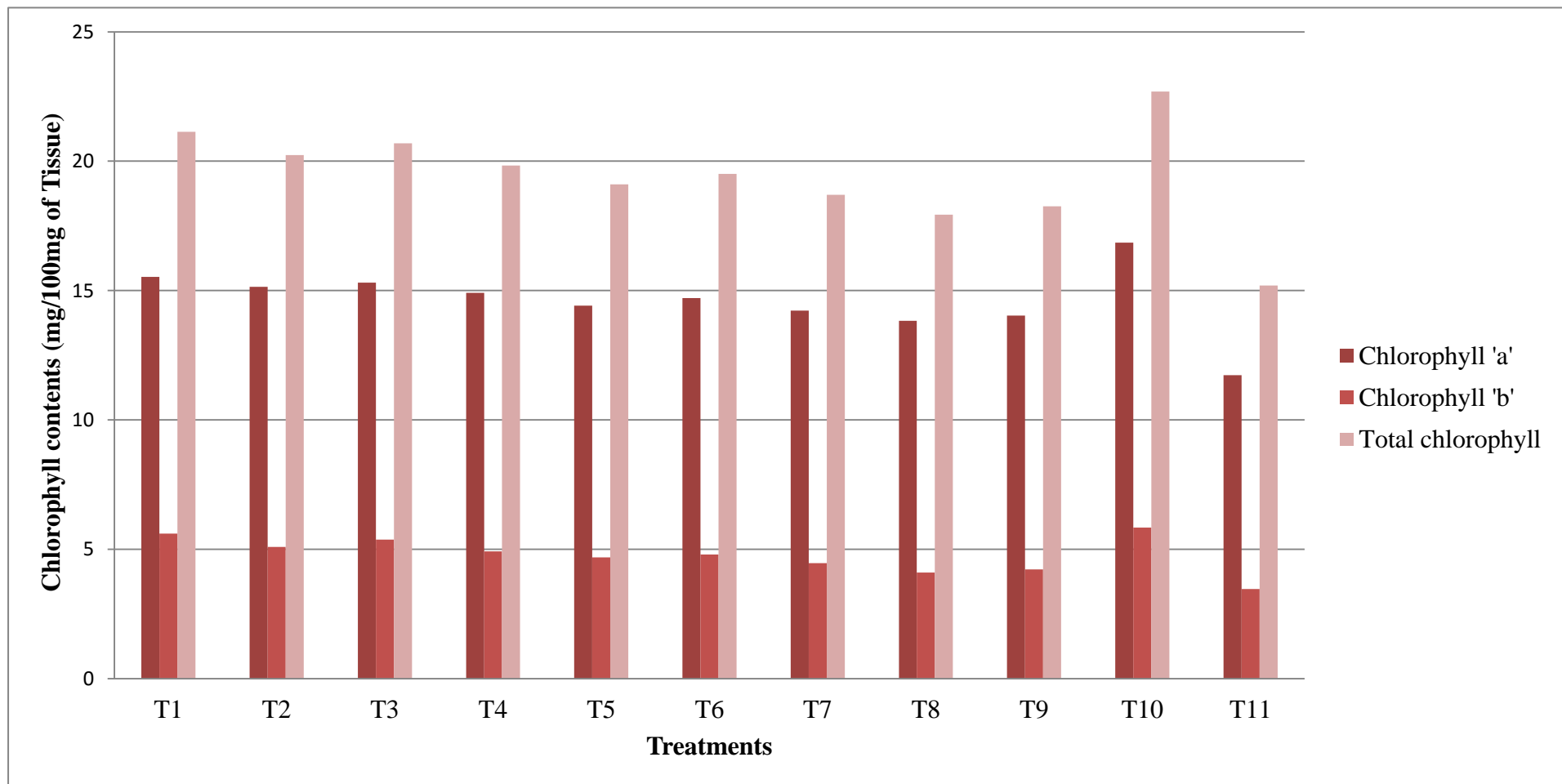


Fig.4.3.1 Effect organic manures and biofertilizers on chlorophyll contents (mg 100 mg⁻¹) at 60 DAS of kasuri methi var. Pusa Kasuri

Table 4.4.1 Effect of organic manures and biofertilizers on available N, P and K (kg ha^{-1}) in soil before sowing and after harvest of kasuri methi var. Pusa Kasuri

Treatments (T)	Nitrogen (kg ha^{-1})	Phosphorous (kg ha^{-1})	Potassium (kg ha^{-1})
Before sowing the crop	205.8	44.7	165.45
T ₁ : 100% RDN through FYM (16 t ha^{-1}) + AMC (7.5 lit ha^{-1})	186.18 ^b	44.89 ^b	168.91 ^a
T ₂ : 100% RDN through Neem cake (2 t ha^{-1}) + AMC (7.5 lit ha^{-1})	175.42 ^b	43.52 ^{bcd}	161.02 ^{abc}
T ₃ : 100% RDN through Vermicompost (4 t ha^{-1}) + AMC (7.5 lit ha^{-1})	181.83 ^b	44.26 ^{bc}	165.53 ^{ab}
T ₄ : 75% RDN through FYM (12 t ha^{-1}) + AMC (7.5 lit ha^{-1})	160.17 ^c	41.85 ^{cde}	156.37 ^{abcd}
T ₅ : 75% RDN through Neem cake (1.5 t ha^{-1}) + AMC (7.5 lit ha^{-1})	151.95 ^{cde}	40.95 ^{def}	150.27 ^{bcd}
T ₆ : 75% RDN through Vermicompost (3 t ha^{-1}) + AMC (7.5 lit ha^{-1})	155.37 ^{cd}	41.60 ^{def}	153.14 ^{abcd}
T ₇ : 50% RDN through FYM (8 t ha^{-1}) + AMC (7.5 lit ha^{-1})	145.84 ^{de}	39.68 ^{efg}	146.53 ^{cd}
T ₈ : 50% RDN through Neem cake (1 t ha^{-1}) + AMC (7.5 lit ha^{-1})	140.41 ^e	38.17 ^g	141.63 ^d
T ₉ : 50% RDN through Vermicompost (2 t ha^{-1}) + AMC (7.5 lit ha^{-1})	142.51 ^e	39.19 ^{fg}	143.88 ^{cd}
T ₁₀ : 50% RDN through FYM (8 t ha^{-1}) + 50% RDN through Neem cake (1 t ha^{-1}) + 50% RDN through Vermicompost (2 t ha^{-1}) + AMC (7.5 lit ha^{-1})	198.42 ^a	49.22 ^a	170.80 ^a
T ₁₁ : Control (without any application)	112.85 ^f	27.91 ^h	122.03 ^e
SEm \pm	4.08	0.89	6.23
CD at 5%	12.04	2.63	18.37

Note : Available N, P and K in soil before sowing are not considered for analysis

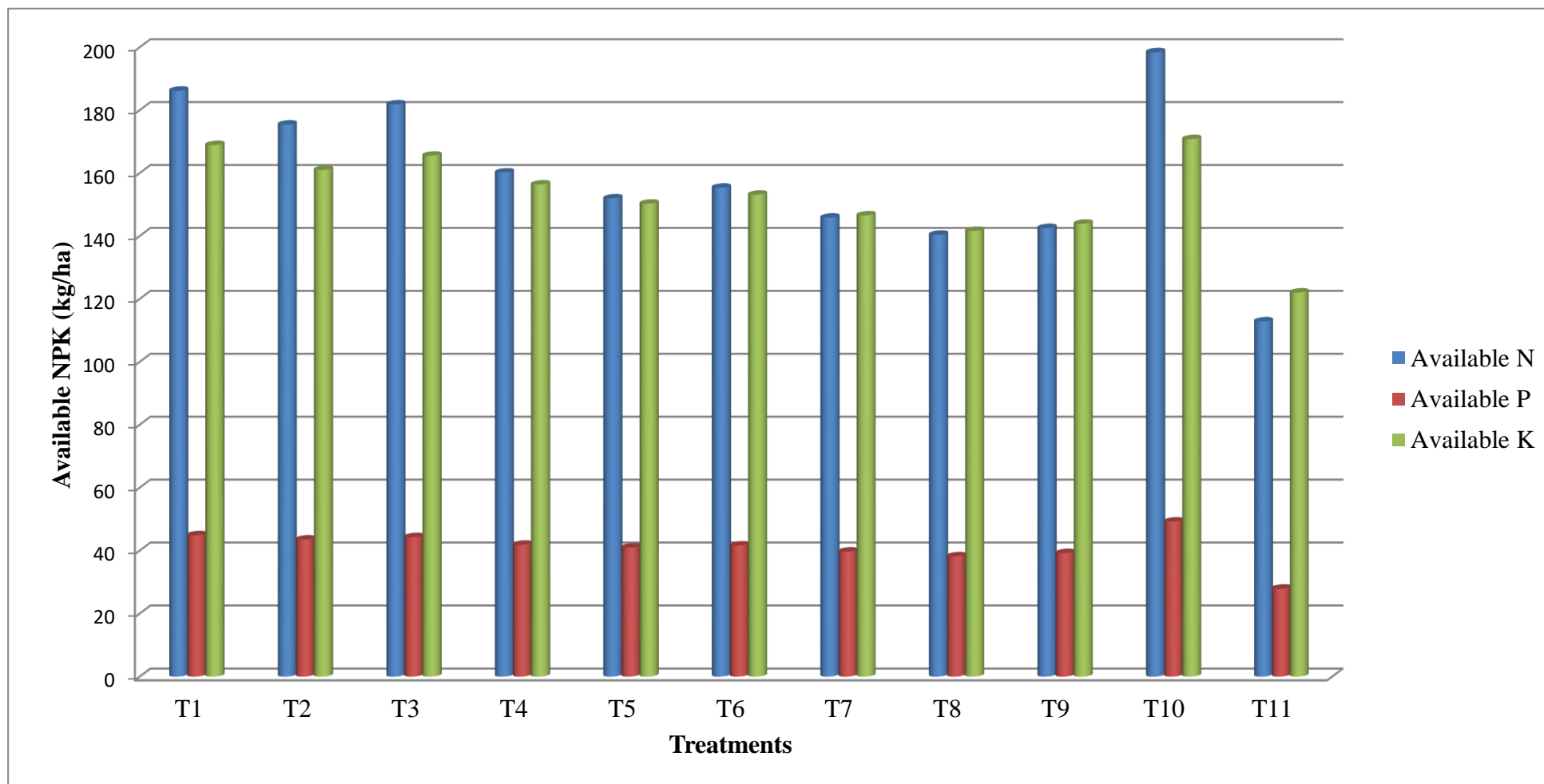


Fig.4.4.1 Effect of organic manures and biofertilizers on available N, P and K (kg ha^{-1}) in soil before sowing and after harvest of kasuri methi var. Pusa Kasuri

Table 4.4.2 Effect of organic manures and biofertilizers on nitrogen content (%) in herb, straw and seed of kasuri methi var. Pusa Kasuri

Treatments (T)	Nitrogen content (%)		
	Herb	Straw	Seed
T ₁ : 100% RDN through FYM (16 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	1.38 ^{ab}	1.06 ^b	2.81 ^{ab}
T ₂ : 100% RDN through Neem cake (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	1.31 ^{cd}	0.96 ^{cd}	2.71 ^{bc}
T ₃ : 100% RDN through Vermicompost (4 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	1.35 ^{bc}	0.99 ^c	2.76 ^b
T ₄ : 75% RDN through FYM (12 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	1.27 ^d	0.93 ^{cde}	2.69 ^{bcd}
T ₅ : 75% RDN through Neem cake (1.5 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	1.19 ^{ef}	0.89 ^{ef}	2.60 ^{cde}
T ₆ : 75% RDN through Vermicompost (3 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	1.24 ^{de}	0.91 ^{def}	2.66 ^{bcde}
T ₇ : 50% RDN through FYM (8 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	1.15 ^{fg}	0.87 ^{efg}	2.57 ^{de}
T ₈ : 50% RDN through Neem cake (1 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	1.02 ^h	0.82 ^g	2.52 ^e
T ₉ : 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	1.12 ^g	0.85 ^{fg}	2.55 ^{de}
T ₁₀ : 50% RDN through FYM (8 t ha ⁻¹) + 50% RDN through Neem cake (1 t ha ⁻¹) + 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	1.43 ^a	1.19 ^a	2.95 ^a
T ₁₁ : Control (without any application)	0.83 ⁱ	0.70 ^h	2.16 ^f
SEm ±	0.02	0.02	0.05
CD at 5%	0.06	0.06	0.15

Table 4.4.3 Effect of organic manures and biofertilizers on phosphorous content (%) in herb, straw and seed of kasuri methi var. Pusa Kasuri

Treatments (T)	Phosphorous content (%)		
	Herb	Straw	Seed
T ₁ : 100% RDN through FYM (16 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	0.55 ^b	0.37 ^{ab}	0.56 ^{ab}
T ₂ : 100% RDN through Neem cake (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	0.51 ^{cd}	0.34 ^{bc}	0.52 ^{bc}
T ₃ : 100% RDN through Vermicompost (4 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	0.53 ^{bc}	0.36 ^{ab}	0.55 ^{ab}
T ₄ : 75% RDN through FYM (12 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	0.49 ^{de}	0.32 ^{cd}	0.50 ^{cd}
T ₅ : 75% RDN through Neem cake (1.5 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	0.44 ^f	0.30 ^{def}	0.45 ^{ef}
T ₆ : 75% RDN through Vermicompost (3 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	0.47 ^e	0.31 ^{cde}	0.47 ^{de}
T ₇ : 50% RDN through FYM (8 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	0.41 ^g	0.28 ^{efg}	0.41 ^{fg}
T ₈ : 50% RDN through Neem cake (1 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	0.35 ^h	0.25 ^g	0.34 ^h
T ₉ : 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	0.39 ^g	0.27 ^{fg}	0.37 ^{gh}
T ₁₀ : 50% RDN through FYM (8 t ha ⁻¹) + 50% RDN through Neem cake (1 t ha ⁻¹) + 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	0.59 ^a	0.39 ^a	0.58 ^a
T ₁₁ : Control (without any application)	0.22 ⁱ	0.13 ^h	0.21 ⁱ
SEm ±	0.01	0.01	0.01
CD at 5%	0.02	0.03	0.04

Table 4.4.4 Effect of organic manures and biofertilizers on potassium content (%) in herb, straw and seed of kasuri methi var. Pusa Kasuri

Treatments (T)	Potassium content (%)		
	Herb	Straw	Seed
T ₁ : 100% RDN through FYM (16 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	0.57 ^{ab}	0.76 ^{ab}	0.36 ^{ab}
T ₂ : 100% RDN through Neem cake (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	0.54 ^{bc}	0.72 ^{bc}	0.32 ^{cd}
T ₃ : 100% RDN through Vermicompost (4 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	0.55 ^{bc}	0.75 ^{ab}	0.34 ^{bc}
T ₄ : 75% RDN through FYM (12 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	0.52 ^{cd}	0.68 ^{cd}	0.30 ^{de}
T ₅ : 75% RDN through Neem cake (1.5 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	0.48 ^{ef}	0.62 ^{ef}	0.26 ^{fg}
T ₆ : 75% RDN through Vermicompost (3 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	0.50 ^{de}	0.65 ^{de}	0.28 ^{ef}
T ₇ : 50% RDN through FYM (8 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	0.45 ^{fg}	0.59 ^{fg}	0.24 ^{gh}
T ₈ : 50% RDN through Neem cake (1 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	0.41 ^h	0.54 ^h	0.21 ^h
T ₉ : 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	0.43 ^{gh}	0.56 ^{gh}	0.22 ^h
T ₁₀ : 50% RDN through FYM (8 t ha ⁻¹) + 50% RDN through Neem cake (1 t ha ⁻¹) + 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	0.59 ^a	0.79 ^a	0.38 ^a
T ₁₁ : Control (without any application)	0.27 ⁱ	0.34 ⁱ	0.14 ⁱ
SEm ±	0.01	0.01	0.01
CD at 5%	0.03	0.04	0.03

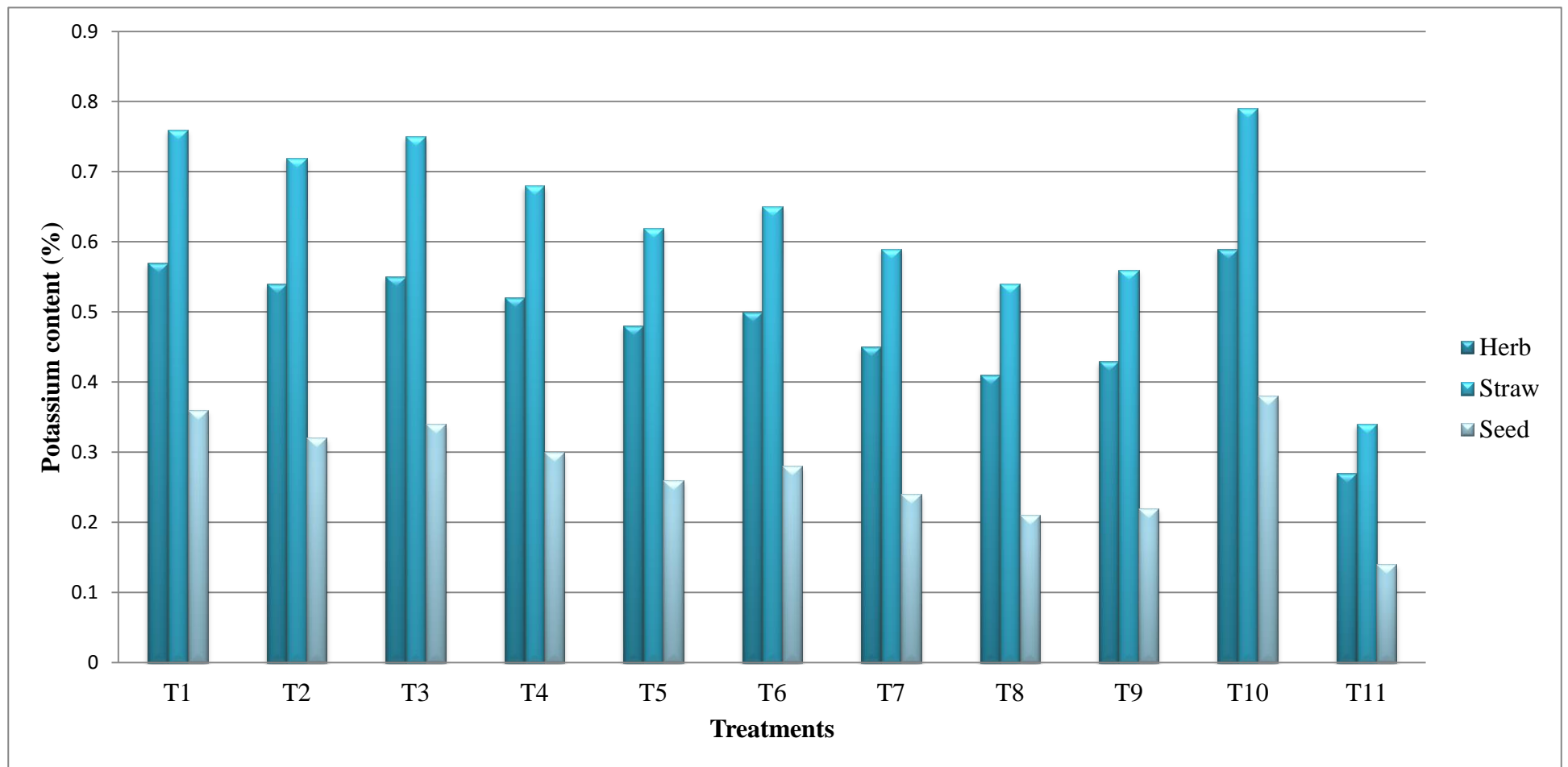


Fig.4.4.2 Effect of organic manures and biofertilizers on potassium content (%) in herb, straw and seed of kasuri methi var. Pusa Kasuri

Table 4.5 Effect of organic manures and biofertilizers on economics of kasuri methi var. Pusa Kasuri

Treatments (T)	Cost of cultivation (₹ ha⁻¹)	Gross returns (₹ ha⁻¹)	Net returns (₹ ha⁻¹)	B:C ratio
T ₁ : 100% RDN through FYM (16 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	65580	191403.0	125823.0	1.91
T ₂ : 100% RDN through Neem cake (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	63580	174991.4	111411.4	1.75
T ₃ : 100% RDN through Vermicompost (4 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	61580	178542.6	116962.6	1.89
T ₄ : 75% RDN through FYM (12 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	57580	156669.0	99089.0	1.72
T ₅ : 75% RDN through Neem cake (1.5 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	56080	143701.4	87621.4	1.56
T ₆ : 75% RDN through Vermicompost (3 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	54580	147615.0	93035.4	1.70
T ₇ : 50% RDN through FYM (8 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	49580	124576.2	74996.2	1.51
T ₈ : 50% RDN through Neem cake (1 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	48580	116496.0	67916.0	1.39
T ₉ : 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	47580	118389.8	70809.8	1.48
T ₁₀ : 50% RDN through FYM (8 t ha ⁻¹) + 50% RDN through Neem cake (1 t ha ⁻¹) + 50% RDN through Vermicompost (2 t ha ⁻¹) + AMC (7.5 lit ha ⁻¹)	78580	238996.2	160416.2	2.04
T ₁₁ : Control (without any application)	30880	60561.4	29681.4	0.96



Before sowing



Application of organic manures



At the time of sowing



At flowering stage



Flowers with pods



Pods harvesting stage

Plate 1. Overall view of the experimental field.



Plate 3. Harvested seed per plot of T₁₀ treatment (50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹))

Chapter V

SUMMARY AND CONCLUSIONS

The present investigation entitled “Efficacy of different organic manures and biofertilizers on kasuri methi (*Trigonella corniculata* L.) var. Pusa Kasuri under Telangana conditions” was carried out during *rabi* season, 2019-20 at College of Horticulture, Rajendranagar, Hyderabad. The experiment was carried out with eleven treatments i.e. T₁ - 100% RDN through FYM (16 t ha⁻¹) + AMC (7.5 lit ha⁻¹), T₂ - 100% RDN through Neem cake (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹), T₃ - 100% RDN through Vermicompost (4 t ha⁻¹) + AMC (7.5 lit ha⁻¹), T₄ - 75% RDN through FYM (12 t ha⁻¹) + AMC (7.5 lit ha⁻¹), T₅ - 75% RDN through Neem cake (1.5 t ha⁻¹) + AMC (7.5 lit ha⁻¹), T₆ - 75% RDN through Vermicompost (3 t ha⁻¹) + AMC (7.5 lit ha⁻¹), T₇ - 50% RDN through FYM (8 t ha⁻¹) + AMC (7.5 lit ha⁻¹), T₈ - 50% RDN through Neem cake (1 t ha⁻¹) + AMC (7.5 lit ha⁻¹), T₉ - 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹), T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) and T₁₁ - Control (without any application) in a Randomized Block Design and replicated thrice. The salient features of the findings are summarized hereunder.

I. GROWTH PARAMETERS:

- Among the treatments, T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded higher plant height, more number of branches per plant and significantly maximum plant spread in both the directions as compared to other treatments.

II. YIELD PARAMETERS:

- The plants provided with T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded significantly maximum fresh and dry herb yield per plant and per hectare over other treatments.

- Maximum number of days taken to first and 50 per cent flowering was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹), while less number of days taken to first and 50 per cent flowering was recorded in T₁₁ – Control (without any application) as compared to the other treatments.
- The plants supplied with T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded significantly maximum number of pods per plant and pod length as compared to other treatments. While, test weight (1000 seed weight) was non significant among the treatments.
- The highest seed yield per plant and per hectare was recorded significantly in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) as compared to other treatments.

III. QUALITY PARAMETERS:

- Significantly T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded maximum crude protein content in herb over other treatments.
- Among the treatments, T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded maximum crude protein content in seed over other treatments.
- Significantly the highest total chlorophyll content was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) as compared to other treatments.

IV. SOIL AND PLANT NUTRIENT STATUS:

- The plants provided with T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded significantly maximum availability of nitrogen and phosphorous content in soil over other treatments.
- Among the treatments, the highest availability of potassium was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) over the others.
- Among the different treatments, significantly more nitrogen, phosphorous and potassium content in herb, straw and seed was recorded in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) as compared to rest of the treatments.

V. ECONOMIC ANALYSIS:

- The highest gross returns (₹ 238996.2), net returns (₹ 160416.2) with benefit cost ratio (2.04: 1) were registered in T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) as compared to rest of the treatments.

CONCLUSION:

- It could be concluded from the present investigation that, different treatment combinations significantly influence the growth, yield and quality of kasuri methi var. Pusa Kasuri.
- Among the treatment combinations, T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) showed positive effect on growth, yield and quality parameters as well as soil and plant nutrient status aspects, followed by T₁ - 100% RDN through FYM (16 t ha⁻¹) + AMC (7.5 lit ha⁻¹) as compared to rest of the treatments.

- With respect to economics, T₁₀ - 50% RDN through FYM (8 t ha⁻¹) + 50% RDN through Neem cake (1 t ha⁻¹) + 50% RDN through Vermicompost (2 t ha⁻¹) + AMC (7.5 lit ha⁻¹) recorded maximum B:C ratio (2.04: 1) followed by T₁ - 100% RDN through FYM (16 t ha⁻¹) + AMC (7.5 lit ha⁻¹) with B:C ratio (1.91: 1) over other treatments.

FUTURE LINE OF WORK:

- Effect of organic manures and biofertilizers with different date of sowing and spacing on growth and yield of kasuri methi need to be evaluated.
- Effect of organic manures and biofertilizers on diosgenin content of kasuri methi need to be investigated.

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APPENDIX – I

Monthly mean meteorological data recorded at ARI, Rajendranagar from October 2019 to February 2020.

Month	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	Rainy days	Sun shine (hrs)	Wind speed (km hr ⁻¹)	Evaporation (mm)
	Maximum	Minimum	Morning	Evening					
OCTOBER, 2019	30	16.6	93	70	4.2	12	5.3	0.2	2.9
NOVEMBER, 2019	29.9	17.7	90	49	0.0	0.0	7.8	0.0	3.0
DECEMBER, 2019	27.8	15.8	92	51.96	0.3	1.0	6.4	0.0	2.6
JANUARY, 2020	29.3	16.1	88	49	0.3	0.0	7.6	0.5	3.4
FEBRUARY, 2020	31.4	15.6	86	41	0.2	0.0	8.5	4.6	4.4

APPENDIX – II

Cost of cultivation of different treatments on Kasuri methi.

Treatment Particulars	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇	T ₈	T ₉	T ₁₀	T ₁₁
Land preparation	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
Seed cost (₹ 160 kg ⁻¹) for 18 kg	2880	2880	2880	2880	2880	2880	2880	2880	2880	2880	2880
Sowing (12 labourers@ ₹ 250 labour ⁻¹)	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
Farmyard manure	32000			24000			16000			16000	
Vermicompost			28000			21000			14000	15000	
Neem cake		30000			22500			15000		14000	
AMC (Arka Microbial Consortium)	2700	2700	2700	2700	2700	2700	2700	2700	2700	2700	
Fertilizer application	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
Irrigation	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000
Plant protection chemicals	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
Weeding	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
Harvesting and Threshing	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000
Transportation & marketing	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
Total cost of cultivation (₹)	65580	63580	61580	57580	56080	54580	49580	48580	47580	78580	30880
Herb yield (kg ha ⁻¹)	6787.67	6263.73	6366.73	5681.13	5319.47	5407.73	4504.89	4197.2	4236.13	8090.53	2164.31
Seed yield (kg ha ⁻¹)	347.81	310.73	320.05	269.04	233.2	246.63	215.49	203.45	209.17	482.41	107.97
Gross returns	191403	174991.4	178542.6	156669	143701.4	147615	124576.2	116496	118389.8	238996.2	60561.4
Net returns	125823	111411.4	116962.6	99089	87621.4	93035.4	74996.2	67916	70809.8	160416.2	29681.4
B:C ratio	1.91	1.75	1.89	1.72	1.56	1.7	1.51	1.39	1.48	2.04	0.96