STANDARDIZATION OF ORGANIC SOURCES IN PIGEON PEA (*Cajanus cajan* (L) Mill Sp.) CULTIVATION UNDER SCARCITY CONDITION

By

Mr. Pawara Mukesh Guman

(Reg. No. 016/028)

A Thesis submitted to the

MAHATMA PHULE KRISHI VIDYAPEETH,
RAHURI - 413 722, DIST. AHMEDNAGAR,
MAHARASHTRA STATE, INDIA.

In partial fulfilment of the requirements for the degree of

MASTER OF SCIENCE (AGRICULTURE)

in

AGRONOMY

Approved by

Dr. S. C. Wadile
(Chairman and Research Guide)

Dr. H. M. Patil
(Committee Member)

Lt. P. B. Deore
(Committee Member)

Dr. R. D. Chaudhari
(Committee Member)

AGRONOMY SECTION,
COLLEGE OF AGRICULTURE, DHULE-424 004
MAHATMA PHULE KRISHI VIDYAPEETH,
RAHURI - 413 722, DIST. AHMEDNAGAR,
MAHARASHTRA, INDIA.

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DHULE-424004

MAHATMA PHULE KRISHI VIDYAPEETH,

RAHURI - 413 722, DIST. AHMEDNAGAR,

MAHARASHTRA, INDIA

2018

CANDIDATE'S DECLARATION

I hereby declare that this thesis or part

there of has not been submitted

by me or other person to any

other University or Institute

for a Degree or

Diploma

Place : College of Agriculture, Dhule. **(M. G. PAWARA)**

Dated : / / 2018

Dr. S. C. Wadile
Assistant Professor of Agronomy,
College of Agriculture, Dhule,
Mahatma Phule Krishi Vidyapeeth,
Rahuri - 413 722, Dist. Ahmednagar,
Maharashtra, India.

CERTIFICATE

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The assistance and help received during the course of this investigation have been duly acknowledged.

Place : College of Agriculture, Dhule. **(S. C. Wadile)**

Date : / / 2018. Research Guide

Dr. S. M. Dhadge
Head,
Department of Agronomy,
College of Agriculture, Dhule
Mahatma Phule Krishi Vidyapeeth,
Rahuri-413722, Dist- Ahmednagar,
Maharashtra State (India)

CERTIFICATE

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Place : College of Agriculture, Dhule. **(S. M. Dhadge)**

Date : / /2018 Head of Department

Dr. A. M. Musmade
Associate Dean,
College of Agriculture, Dhule,
Mahatma Phule Krishi Vidyapeeth,
Rahuri-413722, Dist- Ahmednagar,
Maharashtra State (India)

CERTIFICATE

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Place : College of Agriculture, Dhule. **(A. M. Musmade)**
Date : / /2018 Associate Dean

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MAHARASHTRA STATE, INDIA.

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Place : College of Agriculture, Dhule (M. G. Pawara)

Date : / /2018

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LIST OF ABBREVIATION

&	: and
₹	: Rupees
@	: At the rate of
ºC	: Degree Celsius
%	: Per cent
Agric.	: Agriculture
Agron.	: Agronomy
Anon	: Anonymous
B : C	: Benefit cost ratio
C.D.	: Critical difference
cm	: centi meter
CFU	: Colony forming unit
DAS	: Days after sowing
Dev.	: Development
dm^{-2}	: Decimel per meter square
EC	: Electrical conductivity
et al.	: *et* alia.
etc.	: and other
Fig.	: Figure
FYM	: Farm yard manure
g	: gram
ha	: hectare
HW	: Hand weeding
i.e.	: That is
Int.	: International
J.	: Journal
kg	: kilogram
K_2O	: Potassium oxide
Lit.	: Litre
m	: meter
Max.	: Maximum
Min.	: Minimum

mm.	: Mili meter
N	: Nitrogen
NAR	: Net assimilation rate
No.	: Number
NS	: Non-significant
P	: Phosphorus
P_2O_5	: Phosphorus pentaoxide
q	: quintal
RBD	: Randomized Block Design
RDF	: Recommended dose of fertilizers
Res.	: Research
S.Em. ±	: Standard Error of Mean
t	: ton
VC	: Vermicompost
viz.	: namely
wt.	: Weight

ABSTRACT

"Standardization of organic sources in pigeon pea (*Cajanas cajan* (L) Millsp.) cultivation under scarcity condition"

By

Mr. PAWARA MUKESH GUMAN

A candidate for the degree
of
MASTER OF SCIENCE (AGRICULTURE)
In
AGRONOMY
MAHATMA PHULE KRISHI VIDYAPEETH
RAHURI - 413722
2018

Research Guide	:	Dr. S. C. Wadile Assistant Professor of Agronomy, College of Agriculture, Dhule.
Department	:	Agronomy

The present investigation entitled "Standardization of organic sources in Pigeon pea (*Cajanus cajan* (L) Millsp.) Cultivation under scarcity condition." was under taken at Department of Agronomy farm, College of Agriculture, Dhule (M.S.) during *kharif* season of 2017. The soil of experimental field was clays in texture, low in Nitrogen, medium in phosphorus, fairly rich in potassium.

The experiment was laid out in Randomized block design (RBD) with three replications. There were eight treatments *viz*., T_1 : FYM 5 ton ha^{-1}, T_2 : Vermicompost 3 ton ha^{-1}, T_3 : FYM 2.5 + Vermicompot 1.5 ton ha^{-1}, T_4 : 100 % N through FYM, T_5 : 100 % N through vermicompost, T_6 : 50 % N through FYM + 50 % N through vermicompost, T_7 : Recommended Dose of fertilizers and T_8 : control.

During *kharif* season at harvest the different growth attributes of pigeon pea like plant height (210.63 cm), number of primary branches $plant^{-1}$ (7.89), number of secondary branches $plant^{-1}$ (18.21), No. of leaves $plant^{-1}$(202.89), leaf area $plant^{-1}$(62.02), leaf area index (36.43) and dry matter $plant^{-1}$ (221.47g) and number of root nodules $plant^{-1}$ (40.68). recorded significantly maximum due to the application of 100 % N through Vermicompost (T_5) treatment which was at par with Vermicompot 3 ton ha^{-1} (T_2), and FYM 2.5 + vermicompost 1.5 ton ha^{-1} (T_3) treatment, 100 % N through FYM (T_4) than the control treatment(T_8).

The growth analysis characters at harvest *i.e*. Crop Growth Rate (CGR), Relative Growth Rate (RGR) and Net Assimilation Rate (NAR) were also found significant in treatment 100 % N through vermicompost (T_5) which was at par with vermicompost 3 ton ha^{-1}. Whereas the significantly minimum value are recorded in control treatment at all growth stages.

The yield attributing characters like number of pods plant^{-1} (174.49), number of seeds pod^{-1} (3.91), seed yield plant^{-1} (41.20 g) and weight of 100 seeds (12.17 g) were recorded significantly higher in treatment application of 100 % N through vermicompost. Whereas significantly higher seed yield (16.05 qt.ha^{-1}), stover yield (41.62 qt.ha^{-1}) and harvest index (27.83) was obtained from the treatment 100 % N through vermicompost (T_5) which was at par with vermicompost 3 ton ha^{-1}, and Recommended Dose of fertilizers, 100 % N through FYM, FYM 5 ton ha^{-1}, FYM 2.5 + vermicompost 1.5 ton ha^{-1}, 50 % N through FYM + 50% N through vermicompost. In terms of quality aspect, the treatment 100 % N through vermicompost (T_5). recorded significantly higher protein content (20.53 %) than all the other treatment except control .

The available nutrients like nitrogen, phosphorus, pH, EC and organic carbon in the soil after harvest of pigeon pea due to various organic sources treatments were observed to be significantly higher in 100 % N through vermicompost treatment which was at par with all other treatments except control and potassiumin vermicompost 3 ton ha^{-1} is higher than the other treatment.

Microbial population of bacteria (38.11 CFU × 10^{-6} g^{-1} soil), fungi (36.45 CFU × 10^{-4} g^{-1} soil) and actinomycetes (48.06 CFU × 10^{-4} g^{-1} soil) in the soil were also recorded significantly higher in the treatment 100 % N through vermicompost and all other treatment except control.

Similarly, gross monetary returns (₹. 91635 ha^{-1}) was recorded maximum due to the application of 100 % N through vermicompost than the all other treatment, but Net returns (₹. 34454 ha^{-1}) was recorded maximum in Recommended Dose of fertilizers (T_7) treatment. Benefit cost ratio (1.77) was recorded maximum in the treatment application of 100 % N through FYM (T_4), FYM 5 ton ha^{-1} (T_1) and Recommended Dose of fertilizers (T_7) treatment than the control (T_8) treatment.

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1. INTRODUCTION

Pigeon pea (*Cajanus cajan* (L.) Millsp.), is commonly known in India as *Arhar or Tur* in Hindi and also *Arhar* in Bengali, other local names in different Indian languages being *Tuver, Thuvarai, Kandulu, Thogari* and *Thuvaran.* It is the second most important pulse crop in India, only next to chickpea, in respect of both area and production. It is mainly a *kharif* crop, but can also be grown in winter (*rabi*) season. With the development of short-duration varieties, the cultivation of pigeon pea in summer season is also receiving increasing attention of farmers particularly in the intercropping systems in north and north-eastern states. The Indian sub-continent alone contributes nearly 92 per cent of the total pigeon pea production in the world.

It occupies 4.75 million hectare area in world producing 3.68 million tons with average productivity of 722 kg ha^{-1} during 2016. In India, area and production of pigeon pea is 36.3 lakh hectare and 27.6 lakh tons, respectively with average productivity is 760 kg ha^{-1} during *kharif*-2016 (Anonymous 2016). In Maharashtra, the area and production of pigeon pea is about 12.37 lakh ha and 4.44 lakh tons respectively, with average productivity is 359 kg ha^{-1} during 2016. Hence, there is lot of scope to increase the yield of pigeon pea in Maharashtra as compared to world's average production. The yield of pigeon pea is limited by number of factors such as agronomic, pathogenic, entomological, genetic and there interaction with environment. Among the different factors, soil moisture becomes the most limiting factor in production of pigeon pea especially in areas having scanty and erratic rainfall.

The seeds of pigeon pea are highly nutritious and rich in protein, carbohydrates, fiber and minerals (iron and iodine). It supplies a major share of the protein requirement of the vegetarian population of the country. Seeds of *arhar* are rich in essential amino acids like lycine, tyrocene, cystine and arginine. It is a legume crop and possesses valuable properties as restorer of nitrogen to the soil.

It is being grown in India since long time and is largely consumed in the form of split pulse (*dal*). Besides, it has many uses. Tender green pods constitute a very favourable vegetable in some parts of the country. The husk of pods and seed coat together with broken parts of kernel provide a very valuable feed to milch cattle. In south India and some other places, young green leaves are fed to animals and silkworm. Plants are also utilized for green manuring and live fence and to culture lac-producing insects. Stalks are used for roofing, making baskets and wall of bullock cart shade, thatching materials and as fuel wood. The tall deep-rooted varieties of *arhar* make excellent wind breaks and shade for all type of tender plants. In hilly slopes, plants may be used to check soil erosion and they hold a possibility of their use for making paper pulp (Nene and Sheila, 1990).

The term 'organic agriculture' refers to a production system which avoids or minimizes the use of synthetic fertilizers, pesticides, and growth regulators in crop growing and additives in animal feed. Organic agriculture maximizes the use of crop rotation, crop residues, animal manure, legumes, green manure, off-farm organic waste and biological pest control in order to maintain soil productivity, supply plants with necessary nutrients, and control insects, weeds and other pests cited in Lampkin, 1990). The role of organic agriculture is to maintain or improve soil quality and sanitary condition (Ekwue, 1992), *i.e*., to maintain the quality of agricultural produce without jeopardizing the environment. In that context it is important for all cultural practices to be aimed at the maintenance and improvement of soil fertility, *i.e*., the prevention of soil degradation. The last but not the least, organic agriculture contributes to biodiversity improvement (Paoletti *et* al., 1992).

Organic farming is holistic management system which promotes and improves the health of agrosystem related to biodiversity nutrient bio-cycles and soil microbial and bio-chemical activities. Organic farming in India is not new earlier before use of chemicals, manures like FYM, compost, green manures etc. were already known to Indian farmers for improving soil fertility and crop productivity. However, negligence of organic inputs resulted in deterioration of productive soil for maintaining soil physic-chemical and biological properties. For increasing the productivity of soil, use of FYM and vermicompost in combination may prove to be beneficial.

The importance of organic manures in agriculture is known since ancient times and found mentioned in ancient Hindu religious scriptures of Rig Veda. Organic manure is the life of soil and if neglected, the fertility of soil would not be maintained.

Several thoughts *viz*., organic food tastes better and is of superior quality; organic food is more nutritious and safe; organic farming is ecofriendly; organic farming improves soil fertility and chemical fertilizers deteriorates it; organic manures are considered good source of plant nutrients etc. are made on organic manures. These thoughts have been proposed by researchers, farmers and teachers in the field of agriculture.

In a cropping season, pigeon pea plants fix about at 40 kg ha^{-1} atmospheric nitrogen and add valuable organic matter to the soil through fallen leaves. Also, legumes can fix as much as 200 kg N ha^{-1} $year^{-1}$ under optimal field conditions. Such fixation of N can only be activated in the presence of efficient rhizobial strains which can be added to the soil introduced in form of commercial inoculants. Organic manure can improve soil content from organic matter and this in turn led to improve soil conditions. For maximum exploitation of organic matter, mineralization of manure by its flora led to utilize the organic manure. Therefore, application of organic and mineral nitrogen fertilizers together may increase the exchangeable water soluble of N P K and the uptake of these.

FYM contains many species of living organisms which release phytohormones as GA_3, IAA and CYT which stimulates plant growth, absorption of nutrients.there is a growing interest among the farmers to cultivate crops under organic farming because of the escalating cost of inorganic fertilizers, decreased soil fertility, environmental and health concerns due to pesticide usage and expected premium prices for organically grown crops (Ramesh *et* al 2005). One of the important aspects of organic farming is the soil fertility or nutrient prepared from farm wastes is an important way of recycling nutrients to the management to optimize the crop productivity.

Vermicomposting is a type of composting in which certain species of earthworm used to enhance the process of organic waste conversion and produce a better end-product. Vermicomposting is a mesophilic process utilizing microorganisms and earthworms. Eartworms feeds the organic waste materials and passes it through their digestive system and gives out in a granular form which is known as vermicompost. The use of manures from livestock and the composts soil.

The present experiment was therefore conducted on "Standardization of organic sources in pigeon pea (*Cajanas cajan (*L) Millsp.*)* cultivation under scarcity condition" for which organic inputs is better to build of the soil fertility as well as soil microbial population and to give sustainable yield, hence the experiment was undertaken during *kharif* season of the year 2017 at Post Graduate Research Farm, College of Agriculture, Dhule (Maharashtra) with following objectives.

1) To study the effect of organic farming on growth and yield of pigeon pea.
2) To study the effect of organic farming on soil health.
3) To study the economic feasibility of organic farming.

2. REVIEW OF LITERATURE

Field experiment entitled,“ **Standardization of organic sources in pigeon pea (*Cajanus cajan* (L.) Millsp.) Cultivation under Scarcity condition’’** was carried out during the *kharif* 2017. This chapter deals with the research work carried out the study the effect of organic farming on growth and yield of pigeon pea and soil health. Here an attempt has been made to present a brief review on these aspects as under:

2.1 Effect on growth.

2.2 Effect on yield.

2.3 Effect on soil property.

2.4 Economics

2.1 Effect on growth

Johansen *et* al. (1992) these experiment conducted at Gwalior, India to study a Variety BSMR-736 produced significantly taller plants, more number of branches plant^{-1}, recorded significantly higher root nodule count plant^{-1} and accumulated significantly higher dry matter plant^{-1} as compared to Vipula, Konkan Tur-1 and ICPL-87 at harvest during both the years. The reason for high dry matter accumulation in BSMR-736 may be traced to the significant increase in morphological parameters viz., plant height, number of branches plant^{-1} and number of root nodules plant^{-1} which are responsible for the photosynthetic capacity of an individual plant.

Bansode (1994) this experiment conducted at MPKV, Rahuri and revealed that application of vermicompost recorded significantly higher pigeon pea values for plant height, number of branches, leaf area, total dry matter plant^{-1}, 100 seed weight and percent crude protein content than rest of the alone farmyard manure, compost used and the absolute control. However, application of vermicompost, farmyard manure and compost were at par with each other and recorded significantly higher seed yield than absolute control.

Sarkar *et* al. (1997) an experiment was conducted during the rainy season of 1987 and 1988 at Hazaribagh (Bihar), to study the effect of levels and sources of phosphorus with and without farmyard manure on pigeon pea (*Cajanus cajan* L. Mill sp.) Application of 10 tonnes farmyard manure ha^{-1} gave significantly higher grain yield of pigeon pea 16.7 % over no farmyard manure. P @ 90 kg P_2O_5 ha^{-1} resulted in 6.36 % higher yield than P @ 45 kg P_2O_5 ha$^{-1.}$ Among the P sources, single superphosphate was found superior to rock phosphates. Application of 45 and 90 kg P_2O_5 ha^{-1} when supplied through single superphosphate proved equally effective on pigeon pea in presence of farmyard manure only in lime-treated oxisol.

Jat and Ahlawat (2004) conducted an experiment during winter and summer seasons of 1999-2000 and 2000-01 at IARI, New Delhi and reported that application of vermicompost @ 3 t ha^{-1} significantly increased the growth (dry matter accumulation $plant^{-1}$ and leaf-area index), yield attributes (pods $plant^{-1}$) and seed yield, straw yield of chick pea over no vermicompost. Dry fodder yield of maize increased significantly by the application of vermicompost to preceding chickpea over no vermicompost application in chickpea-maize cropping sequence.

Reddy *et* al. (2004) a field experiment was conducted at Central Research Institute for Dryland Agriculture, Hyderabad, Andhra Pradesh. reported that application of FYM to pigeon pea produced significantly higher seed yield, nodules $plant^{-1}$, nodule dry weight, primary branches and 100 seed weight than that of control. However, stover yield, secondary branches $plant^{-1}$, pods $plant^{-1}$, pod length $plant^{-1}$ and seeds pod^{-1} of pigeon pea were conspicuously higher in FYM over control.

Singh and Rai (2004) a field experiment was conducted during the rainy season of 2000 and 2001 at the Indian Agricutlural Research Institute, New Delhi, to study the effect of integrated nutrient management in soybean [*Glycine max* (L.) Merr.] on its yield attributes, seed yield and quality attributes. The treatments included recommended rate of NPK fertilizers alone or in combination with zinc @ 25 kg $ZnSO_4$ ha^{-1} or FYM @ 5 tonnes ha^{-1} or biofetilizers or wheat (*Triticum aestivum* L. emend. Fiori & Paol.) residue incorporation @ 5 tonnes ha^{-1}. The application of recommended level of NPK with FYM and biofertilizers showed superiority for pods $plant^{-1}$, seeds pod^{-1}, 100-seed weight, seed yield, protein and oil content in soybean seed over the sole application of recommended NPK level. The combined application of NPK + FYM + biofertilizer recorded the highest number of pods $plant^{-1}$ (38.45 and 37.89), seeds pod^{-1} (2.90 and 2.87) and 100-seed weight of soybean during 2000 and 2001 respectively. The highest protein content was recorded in treatment receiving NPK + FYM + crop residue (39.43 and 38.12% in 2000 and 2001 respectively), while the highest oil content in treatment receiving NPK+FYM + BF.

Sharma *et* al. (2009) to study a field experiment was conducted at Agricultural Research Station, Gulbarga on vertisols during *Kharif* season of 2000, 2001 and 2002 to study the response of pigeon pea to conjunctive use of organic and inorganic fertilizers. The results revealed that application of FYM @ 5t ha^{-1} + Seed inoculation with Rhizobium + Micronutrient ($ZnSO_4$ @ 15 kg ha^{-1}) + crop residue @ 5 t ha^{-1} recorded significantly higher plant height (184.09), primary branches (12.34), secondary branches (7.86) per plant, seed yield (15.81 q ha^{-1}) and was on par with the treatment receiving FYM + Seed inoculation with Rhizobium + Micronutrient ($ZnSO_4$ @ 15 Kg ha^{-1}).

Goud and Kale (2010) reported A field experiment was conducted at Pulses Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola - 444 104, Maharastra, India. during *Kharif* 2007–08 to 2009–10 to study the effect of fertilizer, farm yard manure and biofertilizer on growth and yield of pigeon pea. The result revealed that application of 18:46:20:20 kg N:P:K:S ha^{-1} recorded significantly higher grain yield over 9:23:10:10 kg N:P:K:S ha^{-1} during the individual years as well as on pooled basis.

2.2 Effect on yield

Singh and Sahasrabudhe (1957) a field experiment was conducted at Institute of Plant Industry, Indore on effect of organic and inorganics on the yield of jowar *Sorghum vulgare*, arhar *Cajanus cajan* and groundnut *Arachis hypogaea* and after effect on rainfed cotton reported that when the crop was supplied with nitrogen @ 50 kg in the form of farm compost, there was increase in grain yield of arhar

Helkiah *et* al. (1981) a field experiment was conducted at Tamil Nadu Agricultural University, Coimbatore to evaluate the efficacy of organic sources of manures to compared to chemical fertilizers in a black soil revealed that the application of organic sources at different levels in combination with inorganic fertilizers had significantly increased the grain and straw yield of CSH 5 sorghum.

Mathan *et* al., (1994) conducted the field experiments in Tamilnadu reported favorable effect of FYM and micronutrients on seed yield of pigeon pea. The increase in seed yield due to conjunctive use of FYM @ 5 t ha^{-1} + Seed inoculation with Rhizobium + Micronutrient ($ZnSO_4$ @ 15 kg ha^{-1}) + crop residues @ 5 t ha^{-1} was to the tune of 17.0 per cent over application of only FYM @ 5 t ha^{-1} and crop residue @ 5 t ha^{-1}. Interaction effects were found to be non-significant with respect to seed yield of pigeon pea.

Pujari *et* al. (1998) conducted a field experiment at Karnataka agricultural university reported a FYM application @ 5 t. ha^{-1} increased the number of pods $plant^{-1}$, weight of grains $plant^{-1}$, grain yield and stalk yield over no application of FYM

Bhalerao *et* al. (2001) conducted a field experiment during the *kharif* season 1999 at Akola to study effects of integrated nutrient management with vermicompost on growth and yield of rainfed sorghum. RDF 80:40:40 kg NPK ha^{-1} and 0, 1.5 and 3.0 t vermicompost ha^{-1} resulted in the growth characters and yield attributes of sorghum increased with increasing dose of organic fertilizer.

Ramesh *et* al. (2005) a field experiment was conducted at Indian institute of soil science, Nabi bagh, Bhopal reported in Pigeon pea (*Cajanus cajan* L. mill Sp.) all the yield attributes,

seed yield and protein content from the plots under VC treatment were similar with that of chemical fertilizer treatment

Patil and Padmani (2007) a field experiment was conducted during *kharif* 2001-02 at department of agronomy, college of agriculture, junagadh agriculture university, junagadh (Gujarat) India to study the effect of integrated nutrient management on pigeon pea crop with the treatments comprised of biofertilizers, farmyard manure, recommended dose of fertilizers and their all possible combinations. The results revealed that the pigeon pea seeds inoculated with Rhizobium plus P. striata significantly increased the content as well as uptake of nitrogen, phosphorus and potassium by grain as well stalk over uninoculated control. Similar trend was also observed with application of FYM 5 t ha^{-1} over control (No manure). Pigeon crop fertilized with 75 and 100 % RDF ha^{-1} were found equally effective and significantly superior over 50 % RDF ha^{-1} and control with respect to content and uptake of nitrogen, phosphorus and potassium by grain as well as stalk. However the highest values of these parameters were recorded with 100 % RDF ha^{-1}.

Reddy *et* al. (2009) conducted the field experiment was conducted at A. P. Water Management Project, Regional Agricultural Research Station, Jagtial (A.P.), India to study the effects of different organic and inorganic sources of nitrogen on yield and yield attributes of soybean in soybean-maize cropping system. Higher soybean yields 13.30 and 12.50 q ha^{-1} were obtained with the application of 75 % recommended dose of nitrogen and 100 % recommended dose of PK through inorganic fertilizers + 25 % recommended dose of nitrogen through vermicompost. Effective nodules and oil contents were not significantly influenced by different treatments.

Zadode *et* al. (2009) reported a field experiment was conducted on PKV-TARA pigeon pea during the *Kharif* season of 2009-10 at Pulse Research Unit, Dr. Punjabrao Deshmukh Krishi Vidyapeeth, Akola reported that growth and yield attributes were significantly increased due to the increased level of fertilizer. Incorporation of FYM @ 5 t. ha^{-1} significantly increased the yield parameters like shelling per cent, 100 seed weight and grain yield.

Pandey *et* al. (2013) a field experiment was conducted for six consecutive years during 2005–06 to 2010–11 at Tirhut College of Agriculture, Dholi, Bihar reported that application of FYM @ 5.0 t ha^{-1} or vermicompost @ 2.5 t ha^{-1} with 100 % RDF proved equally effective for enhancing the grain yield of pigeon pea and both produced significantly higher grain yield than RDF alone.

Mishra *et* al. (2015) A field experiment was conducted during rainy-cum-winter seasons of 2013-14 and 2014-15 at the Private Research Farm, Benda-Semaria Road, Rewa (M.P.) to study the effect of organic and inorganic sources of nutrients on growth, yield and quality of

pigeon pea (*Cajanus cajan* (L) Millsp). Amongst the applied organic sources of nutrients, farmyard manure (10 t FYM ha^{-1}) resulted in maximum growth (plant height 174.78 cm, primary, secondary and tertiary branches 24.1, 63.1 and 49.3 $plant^{-1}$, respectively, triafoliates 255.9 $plant^{-1}$, dry matter 37.75 g $plant^{-1}$, root nodules 8.46 and its dry weight 0.23 g $plant^{-1}$), yield attributes (pods 222.4 $plant^{-1}$, pod length 2.25 cm, grains 4.52 pod^{-1} and 100-grain weight 13.25 g). Application of 10t FYM ha^{-1} produced. The maximum grain and straw yield (11.83 and 57.14 q ha^{-1}) with additional net income of Rs.16704 ha^{-1} over control. Application of 100 % RDF (N-20:P-60:K-20) produced maximum grain and straw (11.18 and 48.92 q ha^{-1} , respectively) giving extra net income of Rs. 13487 ha^{-1} over control.

Arabhanvi *et* al. (2015) A field experiment was conducted at Department of Agronomy, University of Agricultural Sciences, Dharwad to study the pigeon pea [*Cajanus cajan* (L.) Millsp.] is an important pulse crop grown for its dhal, fuel, and fodder belonging to the family fabaceae. It is an important crop amongst pulses and ranked second after chickpea in India in terms of area and production. It provides protein rich food, firewood and income for resource poor small farmers. It is a protein rich legume grown throughout the tropical and subtropical regions of the world between 30° N and 35° S latitudes. However, in India major area under pigeon pea is lying between 14° and 28° N latitudes, which occupies an area of about 3.81 m ha with a production of 3.02 mt and average productivity of 806 kg ha-1. Integrated nutrient management practices are essential in realizing the higher productivity of pigeon pea and reducing cost of production on sustainable basis

Shivanand Pradeep *et* al. (2017) A field experiment was conducted during *Kharif* season of 2016 to study the effect of organic nutrient management practices on growth and yield of pigeon pea (*Cajanus cajan* (L.) Millsp.) in sandy loam soils of Zonal Agricultural and Horticultural Research Station, Navile Shivamogga, Karnataka. Among the different nutrient management treatments, application of recommended dose of FYM along with 100% N equivalent vermicompost has recorded significantly higher grain yield (10.89 q ha^{-1}) as compared to rest of the treatments. Similarly higher pods per plant (223.3 pods $plant^{-1}$) test weight (11.3 g 100 $seeds^{-1}$) yield $plant^{-1}$ (84 g $plant^{-1}$) also recorded with the same treatment and it was closely followed by application of recommended dose of FYM along with application of 100% N equivalent FYM. Maximum soil microbial population at different growth stages were also observed in the treatment which received recommended dose of FYM along with 100% N equivalent vermicompost.

2.3 Effect on soil property

2.3.1. Physico-chemical properties of soil

Rao *et* al. (1980) Field experiments was conducted during 1979 and 1980 on a Vertisol soil at ICRISAT Centre, Hyderabad, India, examined the residual effect of pigeon pea (*Cajanus cajan*) on growth and yield of a following maize crop. Pigeon pea was grown alone or as an intercrop with sorghum fertilized or not with 80 kg N ha^{-1}. Sorghum alone and fallow treatments were included for comparison. In the first year, the sorghum/ pigeon pea intercrop produced the largest grain and dry matter yields, but the yield of intercropped pigeon pea was about 50 % less than that produced by the sole crop. Pigeon pea alone had a large residual effect on maize, increasing grain yield by 57 % and total plant dry matter by 32 % compared with corresponding values after fallow. In comparison, intercrop pigeon pea had little residual effect. Maize following either fallow, sorghum grown alone, with or without N, or the sorghum - pigeon pea intercrop, again with or without N, required fertilizer equivalent to 38–49 kg N ha^{-1} in order to attain yield similar to that of unfertilized maize following sole crop pigeon pea.

Mahajan *et* al. (1989) A field experiment conducted at department of soil science, MPKV, Rahuri noted that application of farmyard manure reduced electrical conductivity of soil from 9.2 to 1.93 per cent, exchangeable sodium from 23.4 to 4.8 per cent.

Badanaur *et* al. (1990) A field experiment was conducted at department of Soil Science, Agricultural Research Station, Bijapur, Karnataka, India to study the effect on crop growth and physical and chemical properties of a vertisol. The performance of the crop residues was compared with fertilizers, applied at 50 kg N + 25 kg P_2O_5 ha^{-1} or 25 kg N + 12.5 kg P_2O_5 ha^{-1}. The incorporation of leucaena loppings at 5 t ha^{-1} gave grain yields of *rabi* sorghum which was on a par with that obtained with 50 kg N + 25 kg P_2O_5 ha^{-1}. Sunnhemp applied at 5 t ha^{-1} gave the highest sorghum grain yield of 1.67 t ha^{-1} followed by 25 kg N and 12.5 kg P_2O_5 ha^{-1} (1.54 t ha^{-1}). The application of sorghum stubbles and safflower stalks at 5 t ha^{-1} each gave significantly lower yields compared with sunnhemp and leucaena loppings. However, the incorporation of sorghum stubbles and safflower stalks significantly increased the infiltration rate, bulk density and water content at field capacity as compared with the fertilizer treatment. The effects on organic carbon, available N and available P with leucaena, sunnhemp and farmyard manure were similar.

Bhawalkar *et* al. (1991) observed that the use of vermicompost reduced irrigation requirement because of increased water holding capacity, infiltration rate up to 130 mm hr^{-1} by use of vermicompost against the normal value of 10 mm hr^{-1} on conventional farm. He also reported that vermicompost maintained pH near neutral than surrounding soil because of enzymatic activity.

Jambhekar (1991-a) these experiment was conducted on pigeon pea at college of Agriculture Pune and revealed that the percentage of total N was increased in vermicompost

group by 37 per cent over the chemical fertilizer group and nearly by 50 per cent over the control group.

Jambhekar (1991-b) these experiment was conducted on sugarcane at Udaipur agriculture university reported that the application of vermicompost increasing total N than chemical fertilizer and control.

Gunjal and Nikam (1992) these experiment conducted at college of agriculture, Pune in pigeon pea the increase in total nitrogen in soil was found 6.5 times more in vermiculture treatment over control.

Hapse *et* al. (1993) experiment was conducted at agricultural college, Pune and revealed that the organic carbon content of the soil increased by 0.27 per cent due to application of vermicompost as compared to application of chemical fertilizers alone.

Jadhav *et* al. (1993) these experiment conducted at college of agriculture, Pune on pearl millet and revealed that due to use of vermicompost there was an increase in available N, P and K content.

Patil (1993) these experiment conducted on gram at MPKV, Rahuri and revealed that the application of FYM resulted into significant increase in EC, organic carbon and it was found to be most effective in building up the soil organic matter.

Shinde (1997) carried out an experiment at MPKV, Rahuri (Maharashtra) revealed that the effect of FYM, city compost and vermicompost on soil properties and reported that application of 100 per cent recommended dose through FYM and vermicompost decreased the bulk density and increased the pore space and volume of soil over control.

Reddy and Reddy (1998) conducted an experiment at Rajendranagar (Andhra Pradesh) and reported that use of organic manures would not only improved soil health but also helped to sustain crop productivity of soybean-sorghum cropping sequence

Manuring the crop with FYM 5 t ha^{-1} significantly increased the N, P and K content of grain as well as stalk as compared to control. The crop manured with FYM 5 t ha^{-1} resulted in significantly the highest N (3.504 %), P (0.500%) and K (0.828%) content in grain as well as the highest N (1.118 %), P (0.167%) and K (1.705%) content in stalk than control. This improvement in N, P and K contents might be resulted due to the fact that, upon decomposition, FYM release these nutrients and increases their availability in the soil due to production organic acids. Saghin (1998) also reported similar results with application of FYM in horse bean crop.

Awasarmol (2002) A field experiment conducted at MKV, Parbhani (Maharashtra) indicated that application of FYM @ 5 t ha^{-1} , glyricidia @ 20 t ha^{-1}, wheat straw @ 5 t ha^{-1}

proved better moisture conservation, infiltration rate, reduced bulk density over RDF treatments in soybean-sorghum cropping system in vertisol.

Maruthi *et* al. (2002) conducted experiment at Hyderabad and reported that continuous application of FYM for consecutive seven years to rainfed crops like sorghum, soybean increased the organic carbon and N content.

Bonde *et* al. (2004) conducted cotton + soybean intercropping system trial at MKV, Parbhani (Maharashtra) and reported that application of FYM @ 5 t ha^{-1} recorded higher values for nitrogen, phosphorus and potassium availability in soil as compared to control.

Marinari *et* al. (2007) experiment conducted at organic and conventional management in central Italy to study was to evaluate chemical changes in soil organic matter (SOM) in organically and conventionally managed fields, using pyrolytic indices and the extraction of different carbon fractions. Pyrolysis-gas chromatography (Py-GC) was used to study structural changes in SOM, whereas the different soil extractions gave a fractionation of C forms. Organic management increased both humic and labile C forms (microbial biomass C and water soluble organic C). A significant positive relationship was found between the living SOM fraction, expressed as microbial biomass/total organic C ratio (MBC/TOC) and humification rate. A negative relationship was found between the pyrrole to phenol ratio (O/Y) and total extractable C (TEC).

Srikantbhau *et* al. (2012) A field experiment was conducted during 2010-11 under protective irrigation during *rabi* at Agricultural College Farm, Raichur situated in North Eastern Dry Zone (Zone- 2) of Karnataka and located between 16o 151 N latitude and 77o 211, E longitude with an altitude of 389 meters above the mean sea level. The soil of experimental plot was medium black with sandy loam texture having 0.62 per cent organic carbon, 223.70 kg ha^{-1} of available nitrogen, 33.41 kg ha^{-1} of available phosphorous, 295.50 kg ha^{-1} of available potassium, 0.51 ppm available zinc and a pH of 8.26. The entire quantity of recommended dose of fertilizer for pigeon pea (25:50:: N: P_2O_5 kg ha^{-1}) was applied as basal dose at the time of sowing. Sixteen treatment combinations comprising of three organic manures (FYM @ 6 t ha^{-1}, vermicompost @ 1 t ha^{-1} and poultry manure @ 1 t ha^{-1}) with control and four levels of zinc sulphate (No $ZnSO_4$, ZnSO4 @ 10 kg ha^{-1}, $ZnSO_4$ @ 15 kg ha^{-1} and $ZnSO_4$ @ 20 kg ha^{-1}) were laid out in factorial randomized block design with three replications.

Chavan *et* al. (2015) he was conducted during the year 2015-2016 at Department of Soil Science and Agricultural Chemistry, College of Agriculture, Dhule with objectives to assess the chemical and biological properties of organic farm soil and to assess the morphology of representative soil. The geo-referenced 65 soil samples were collected from organic farm College of Agriculture, Dhule by using Global Positioning System (GPS). The pH of soil was

varied from 7.0 to 7.9, while, EC was varied from 0.58 to 0.69 dSm^{-1}. The organic carbon and calcium carbonate content in soil were varied from 5.9 to 6.7 g kg^{-1} and 1.1 to 4.2 per cent, respectively. Soils of organic farm were found neutral to slightly alkaline and non saline in nature. While, moderate to moderately high in organic carbon and low to moderately high in calcium carbonate. The available nitrogen, phosphorus and potassium were ranged from 137 to 299, 12.00 to 23.72 and 252.00 to 293.9 kg ha^{-1}, respectively. Which indicates that soils were very low to moderate in available nitrogen, low to moderately high in available phosphorus and high in available potassium. The exchangeable calcium and magnesium and available sulphur were ranged from 21.9 to 28.9, 11.2 to 16.8 cmol (p+) kg^{-1} and 13.19 to 26.32 mg kg^{-1}, respectively. The 100 per cent soils were sufficient in exchangeable calcium, magnesium and available sulphur. The available iron, manganese, zinc and copper were varied from 4.65 to 17.51, 2.99 to 7.58, 0.57 to 1.78 and 2.65 to 4.82 mg kg^{-1}, respectively. The microbial population like fungi, bacteria and actinomycetes were ranged from 21 to 31 x 104 CFU g^{-1} soil, 36 to 61 x 107 CFU g^{-1} soil and 29 to 39 x 106 CFU g^{-1}soil, respectively.

2.3.2. Biological properties of soil

Sharma *et* al. (1983) these experiment was conducted at Department of Soil Science and Agricultural Chemistry, Birsa Agricultural University, Ranchi, 834006, Bihar to studied effect of continuous application of fertilizer, FYM and lime on microbial population of soil and reported that bacteria, actinomycetes, azotobacter, cellulose decomposers increased in soil treated with FYM application alone or in combination with fertilizers and lime.

Germida *et* al (1988) these experiment was conducted at Saskatchewan Institute of Pedology, University of Saskatchewan, Saskatoon, Saskatchewan, Canada. Application of organic amendments has been reported to stimulate the growth of indigenous Rhizobium leguminous arum and R. melioti in soil.

Suistova and Diuvelikawkh (1992) these experiment was conducted at Voronezh State University, Russia to study sewage sludge from a purification plant in Voronezh was applied in 1989 to 130 ha of autumn-ploughed land, with pH 6.03 and 6.8 % humus, at 50 t ha^{-1}. Nutrient content in the sludge included 1.06-1.08 % N, 2.4-3 % total P, 118-413 mg 100^{-1} g mobile P, and 42-43 mg 100^{-1} g exchangeable K, with pH 6-6.1 and 25-65 % organic matter. Soil samples were taken at maturity of the following winter wheat crop. Microbial composition of the sludge was dominated by eutrophic non-spore-bearing bacterial micro flora, growing on organic sources of N. Application at 50 t ha^{-1} promoted two-fold increase of eutrophic bacteria, actinomycetes, fungi, and celluloytic microorganisms and a 1.5-fold increase in numbers of oligotrophic bacteria. The species range was very varied, mostly including slower-growing fungi in the sludge and faster-growing ones in the soil. Species distribution was little affected. An increase in N

reserves in soil microorganism biomass was observed. Wheat yields increased from 3.0 to 3.7 t ha^{-1}. The stability of species structure among soil fungi, as indicators of heavy metal contamination, demonstrates the large buffering capacity of chernozems.

Kale *et* al. (1994) these experiment conducted at agricultural university Dharwad (India) to observed that the vermicompost on chemical degradation by the enzymes activity in the gut of earthworms and the enzymes of the associated microbial population has long range influence on soil in improving biological properties of the soil.

Tompe and More (1996) A field experiment to study the effect of pressmud cake on soil characteristics of a vertisols was conducted at marathwada agricultural university, during *kharif* season of 1992-93. Pressmud cake showed pronounced effect on improvement of bulk density, and water holding capacity has shown continuous increase with successive increasing doses of pressmud. Higher doses of pressmud decreases pH and EC of soil. Maximum organic carbon content of soil was observed with 15 tonnes of pressmud cake ha^{-1} + 1.4 recommended dose of fertilizer. Application of 15 tonnes pressmud cake ha^{-1} recorded highest bacterial, fungal and azatobacter population whereas treatment recommended dose of fertilizer recorded highest actinomycetes population at all growth stages of sunflower.

Jain *et* al. (2003) After 25 years of Long-term Fertilizer Experiment at Live Stock Fann, JNKVV, Jabalpur it was found that chemical fertilization did not have any negative impact on Nitrosomonas, Nitrobacter and Azotobacter population although they were enhanced as compared to control. Recommended dose of NPK without sulphur was less effective for Nitrosomonas and Azotobacter. FYM application was much superior in maintaining the soil biological health which ultimately reflected on ammonical and nitrate nitrogen. Crop rhizosphere also played a significant impact on the microbial population and mineral nitrogen. Nitrogen transfonnation was significantly increased by nitrosomonas and nitrobacter population in different treatments, it was also increased with increasing levels of NPK.

Parham *et* al. (2003) these work was conducted at Environmental Institute of Oklahoma State University, USDA to study the long term experiment over 10 years and reported that cattle manure application promoted the growth of bacteria but not fungi when compared with the fungi control soils.

A field experiment was conducted by Deshpande and Murumkar (2007) during winter 2005-06 at Zonal Agricultural Research Station, Solapur (Maharashtra) to assess the effect of organic and tillage on microbial population. The results indicated that, at flowering stage mean population of total bacteria, total fungi, beneficial fungi, azotobacter and actinomycetes was highest in the treatment of conventional tillage with 100 per cent N through organics.

Nagar *et* al (2016) A field experiment was conducted to study the effect of organic manures (FYM and pigeon pea stalk) along with phosphor compost on physico-chemical and biological properties of soil in pigeon pea based intercropping system at Pulses Research Unit, Dr Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra during *Kharif* season of 2013-14 on inceptisol. The results revealed that lower bulk density, pH and electrical conductivity, higher organic carbon and available N, P, K and significantly highest soil microbial biomass carbon (SMBC) and microbial population (fungal, bacterial and actinomycetes) were observed in pigeon pea + black gram and pigeon pea + green gram intercropping over sole pigeon pea system. Among combined use of organic manure, FYM + phosphor compost and pigeon pea stalk + phosphor compost resulted in improvement of physical, chemical and biological properties of soil over recommended dose of fertilizer (RDF) application.

2.4 Economics

Yadav and Yadav (1991) from Faizabad reported that the pigeon pea wheat cropping system had higher net profit than sole pigeon pea system (Rs. 1000 ha^{-1} in 1985-86 and Rs. 1523 ha^{-1} in 1987-88). They further explained that the pigeon pea variety T-212 had given the highest benefit cost ratio (1.92 and 1.79 during first and second years). They also stated that the pigeon pea ratooning system gave the highest benefit : cost ratio because of its lower cost of cultivation than rest of the systems.

Powar *et* al. (2004) conducted an experiment at Karjat (Maharashtra) to the suitable organic materials to integrate with chemical fertilizers in rice. Significantly highest available N and P in rice was observed with GLY + NPK treatment, while significantly highest available K was observed with VC + NPK treatment

Morarka (2006) reported that the application of dose about 2500 kg of vermicompost ha^{-1} to onion has been recommended as a substitute for chemical fertilizers. The use of farmyard manure also had been reduced to 50 per cent level of chemical fertilizers.

Palaswar *et* al. (2007) conducted an experiment at Regional Research Centre, Amravati on INM treatments reported that pigeon pea crop responded favourably to the application of FYM and vermicompost and recorded significantly higher values for gross and net monetary returns over no manuring treatment.

Pandey *et* al. (2009) A field experiment was conducted during *kharif* season of 2004-05 at the Agriculture Farm, Rajoula of Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, Satna (M.P.) under rainfed conditions of the pigeon pea crop to revealed that the highest net return was recorded in 100% RDF. Higher return/Re invested was recorded under 50% RDF which was Rs. 1.0 and 0.20 more over control and 100% RDF, respectively due to proportional increase in gross return compared to cost of cultivation

Tyagi and Upadhyay (2015) A field experiment was carried out at Research farm, college of agriculture, Tikamgarh (Madhya pradesh), during summer 2012 and 2013 to study the effect of integrated nutrient management on yield attributes, yield, nutrients uptake and economics of summer green gram. The experiment was laid out in RBD design replicated thrice with ten nutrient management treatments reported the application of 10 t FYM ha^{-1} gave the maximum net income (`.31384 ha^{-1}), followed by 5 t vermicompost ha^{-1} (Rs. 27455 ha^{-1}) and then 5 t poultry manure ha^{-1} (Rs.21612 ha^{-1}). The minimum values of net returns and B:C ratio were realized with poultry manure on account of high cost of poultry manure.

5. SUMMARY AND CONCLUSIONS

The field investigation on "Standardization of organic sources in pigeon pea (*Cajanus cajan* (L.) Millsp.) Cultivation under scarcity condition" was conducted during *kharif* season of the year 2017 at Post Graduate Research Farm, Agronomy Section, College of Agriculture, Dhule, (Maharashtra).

5.1 Summary

The experiment with eight treatments were laid out in randomized block design in three replications with gross and net plot si`ze of 6.00 x 5.40 m^2 and 5.20 x 3.60 m^2, respectively. The eight treatments consisted of T_1- FYM 5 ton ha^{-1}, T_2-Vermicompost 3 ton ha^{-1}, T_3-FYM 2.5 ton + Vermicompost 1.5 ton ha^{-1}, T_4-100 % N through FYM, T_5-100 % N through Vermicompost, T_6 - 50 % N through FYM + 50 % N through Vermicompost, T_7 –RD of fertilizers , T_8- Control. Variety BSMR-736 were sown at 90 cm x 20 cm, Sowing was done on 24th June 2017 and harvested on 28th December of the year 2017. Observations on growth contributing characters of Pigeon pea where recorded periodically at an interval of 28 days upto harvest. The yield and yield contributing characters were recorded at harvest. The available NPK status, pH, EC, Organic carbon, bacteria, Fungi and Actinomycetes in soil was worked out initially and after harvesting by adopting standard methods. The soil of the experimental field was clayey in texture, low in available nitrogen, medium in available phosphorus, high in available potassium and low in organic carbon. The soil was neutral in reaction (pH 7.6). For working out economics, the prevailing market prices of inputs and outputs were considered. Organic sources like FYM, Vermicompost was applied at last harrowing before sowing as per treatment based on its nutrients content.

The important findings of the investigation are summarized as below :

5.1.1 Plant population

The initial and final plant count per ha. where found statistically non-significant. The mean plant population per ha at 15 DAS and at harvest was 54797 and 53822 respectively.

5.1.2 Growth studies

Growth character *viz*., plant height, number of branches, number of leaves, leaf area $plant^{-1}$, leaf area index, crop growth rate, relative growth rate, Net assimilation rate and dry matter accumulation $plant^{-1}$ were influenced by different organic sources treatment.

The plant height, number of branches, number of leaves, leaf area $plant^{-1}$, leaf area index, crop growth rate, relative growth rate, Net assimilation rate and dry matter accumulation $plant^{-1}$

were observed numerically more under 100 % N through vermicompost (T_5) treatment. While it was recorded lowest in control (T_8) treatment, while at par with vermicompost 3 ton ha^{-1} (T_2), followed by FYM 2.5 + Vermicompot 1.5 ton ha^{-1} (T_3) and 100 % N through FYM treatment.

The nodule count at flowering stage was influenced significantly due to treatment 100 % N through Vermicompost (T_5) treatment reported higher nodule count 40.68 $plant^{-1}$ at flowering stage. Followed by 39.63 nodule $plant^{-1}$ Vermicompost 3 ton ha^{-1} (T_2) as compared with the RD of fertilizers (T_7) 30.52 nodule $plant^{-1}$ at the flowering stage.

5.1.3 Yield contributing characters

The important yield contributing characters like number of pods $plant^{-1}$, number of seed pod^{-1}, seed yield $plant^{-1}$ (g) test weight (g), seed yield kg ha^{-1} and stover yield kg ha^{-1} were significantly higher under 100 % N through vermicompot (T_5) treatment all other organic fertilizers treatment. The minimum value recording control treatment.

5.1.4 Yield of Pigeon pea

The seeds yield (qt. ha^{-1}) and stover yield (qt. ha^{-1}) of pigeon pea was found significantly higher (16.05 and 41.62 qt. ha^{-1}, respectively) under treatment of 100 % N through vermicompost (T_5) treatment. Which was at par with all other organic sources combnation. The seeds and stover yield was significantly lowest under control (T_8) treatment.

5.1.5 Quality Study

The protein content of pigeon pea is numerically higher in 100 % N through vermicompost (T_5) at par with vermicompost 3 ton ha^{-1} (T_2), followed by FYM 2.5 + Vermicompost 1.5 ton ha^{-1}(T_3). Whereas the numerically lower value is recorded in control (T_8) treatment.

5.1.6 Chemical properties of soil after harvest

The results revealed that difference in available nitrogen, phosphorous, potassium, pH, EC and Organic carbon in the soil after harvest of pigeon pea (kg ha^{-1}) due to various organic sources treatments were observed to be significantly.

The significantly higher available soil nitrogen (176.53 kg ha^{-1}) was recorded in 100 % N through vermicompost (T_5). Whereas significantly minimum value of available nitrogen was registered by control (T_8) treatment.

The significantly higher available phosphorous in soil (21.42 kg ha^{-1}) was recorded in 100 % N through vermicompost (T_5). Whereas significantly minimum value of available phosphorous was registered by control (T_8) treatment.

The significantly higher available potassium in soil (306.11 kg ha^{-1}) was recorded in vermicompost 3 ton ha^{-1} (T_2). Whereas significantly minimum value of available potassium was registered by control (T_8) treatment.

The chemical properties pH, EC and organic carbon in soil was not influenced significantly.

5.1.7 Soil microbial population

The mean soil microbial population of bacteria, fungi and Actinomycetes 32.25, 33.55 and 42.69 (CFU × 10^{-4} g^{-1} soil) respectively after harvest.

The available of bacteria, Fungi and Bacteria in soil after harvest of Pigeon pea influenced significantly higher in 100 % N through Vermicompost (T_5) treatment as compared to the control (T_8) treatment.

5.1.8 Economics

The mean cost of cultivation, gross monetary return and net monetary return was (₹. 48294, 74973 and 26679) recorded respectively, and B: C Ratio was 1.54.

The cost of cultivation treatment and gross monetary return was recorded maximum in 100 % N through vermicompost (T_5) than the other, net monetary return was recorded maximum in RD of fertilizers (T_7) and B:C ratio was recorded maximum in the FYM 5 ton ha^{-1} (T_1), 100 % N through FYM (T_4) and RD of fertilizers (T_7) than the control (T_8) treatment.

5.2 Conclusion

1. Application of 100 % N through Vermicompost recorded the highest growth, yield and quality of Pigeon pea followed by other combination of organic sources.

2. Microbial population as well as bacteria, fungi and actinomycetes was recorded more values in the treatment 100 % N through vermicompost followed by all other treatments except control.

3. The highest benefit cost ratio where recorded in treatment of FYM 5 ton ha^{-1}100 % or 100 % N through FYM or RD of fertilizers.

4. From the present investigation it can be concluded that for obtaining higher yield and net monetary return to organic Pigeon pea variety BSMR-736 the application of 100 % N through vermicompost, FYM 5 ton ha^{-1}, 100 percentage N through FYM, Recommended

dose of fertilizers respectively was more beneficial under scarcity conditions of Dhule region.

The above results are based on the data of one season and hence need confirmation to draw definite conclusions and arrive at recommendations.

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7. APPENDIX

Appendix I. Prevailing market prices of inputs during 2017.

Sr. No.	Particular	Unit	Rate (₹)
A.	**Operation**		
1.	Ploughing	₹ ha^{-1}	1600
2.	Harrowing	₹ ha^{-1}	1300
3.	Seed	₹ kg^{-1}	150 kg^{-1}
4.	FYM	₹ ton^{-1}	1500
5.	Vermicompost	₹ ton^{-1}	6000
6.	Urea	₹ kg^{-1}	6
7.	SSP	₹ kg^{-1}	7.46
8.	MOP	₹ q^{-1}	11.36
9.	Labour charges Men / Women	₹ day^{-1} $head^{-1}$	235
10.	Harvesting and threshing	₹ ha^{-1}	3525
11.	Cleaning	₹	1175
12.	Seed sale price	₹ q^{-1}	5450
13.	Stover sale price	₹ q^{-1}	100
14.	Land rent	₹	500
15.	Supervision charges	₹	1000

8. VITAE

Mr. PAWARA MUKESH GUMAN

A candidate for the degree of

MASTER OF SCIENCE (AGRICULTURE)

IN

(AGRONOMY)

2018

Title of thesis		**:**	"Standardization of organic sources in pigeon pea [*Cajanus cajan* (L.) millsp.] cultivation under scarcity conditions."
Major Field		**:**	Agronomy
Biographical information		**:**	
Personal	**Date of Birth**	**:**	01 April. 1993
	Place of Birth	**:**	New Boradi, Tal. Shirpur, Dhist. Dhule
	Father's Name	**:**	Shri. Guman Dhana Pawara
	Mother's Name	**:**	Sau. Musibai Guman Pawara
Educational	**Bachelor Degree Obtained**	**:**	Navalbhau college of Agriculture Amalner, Tal.- Amalner Dist. Jalgaon.
	Class	**:**	Second Class
	Name of University	**:**	Mahatma Phule Krushi Vidyapeeth Rahuri-413 722, Dist- Ahmadnagar, Maharasthra, India.
Address		**:**	At / P- New Boradi, Tal.- Shirpur, Dhist.- Dhule
	Email-id	**:**	pawaramukesh1234@gmail.com
	Contact Number	**:**	9623721990