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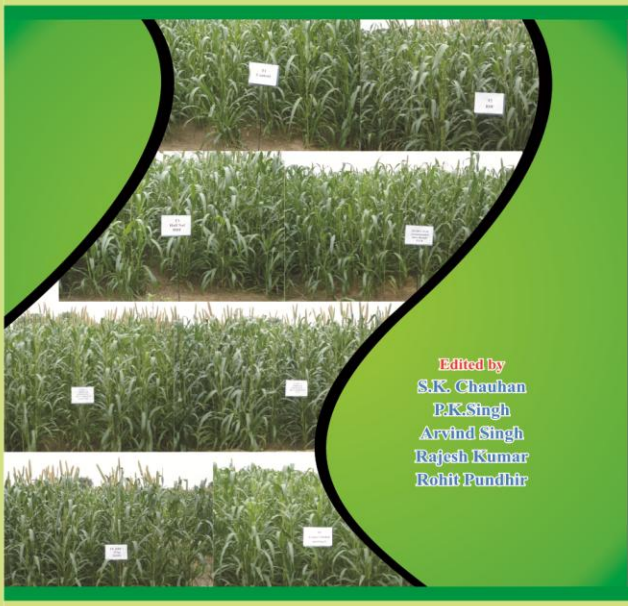
Effect of long term application of organic and inorganic fertilizer on productivity and water use efficiency of pearl millet under rain fed condition



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All India Co-ordinated Research Project For Dryland Agriculture
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FOREWORD

Out of 142 m ha of cultivated area in India, rain fed agriculture extended over 85 m ha across diverse agro-climates, ecological situations and Socio economics settings. In order to address location specific problems, All India Co-ordinated Research Project for dry land Agriculture (AICRPDA) Sub-Center, Agra was started in September, 1971 and has carried out very good research work on dry land agriculture for the last more than four decades. This project is continuing its efforts to generate site specific technologies in the areas of rain water management, soil and water conservation, cropping system, integrated farming systems, drought tolerance varieties, integrated nutrient management, energy management strategies, alternate land use system for stabilize productivity and income.

The technical bulletin" Effect of long term application of organic and inorganic fertilizer on productivity and water use efficiency of pearl millet under rain fed condition" (1984-2018) of AICRPDA is a well compiled document with synthesized information based on 34 years research on Pearl millet crop grown in organic based on different rain fed agriculture technologies. This publication contain some of important impact of organic farming in pearl millet crop grown in rain fed /dry land areas of Agra regions well as Western part of Uttar Pradesh. I hope the information contained in this bulletin will be use full to all research in statistics, institutes, agriculture universities and other stakeholders including NGOs, KVKs involved in the transfer of rain fed agriculture technologies.

I compliment to Dr. S.K.Chauhan, Senior Scientist, Agronomy and all the Scientist involving in bringing out this concise and use full publication: "Effect of long term application of organic and inorganic fertilizer on productivity and water use efficiency of pearl millet under rain fed condition" for benefit of all stakeholders involved in rain fed Agriculture in India

(S.P.Madnawat)

YUVRAJ AMBREESH PAL SINGH
Secretary, Balwant Educational Society
R B S College, Agra

FOREWORD

I am happy to know that AICRP for Dry land Agriculture project of R.B.S.College, Bichpuri, Agra is publishing a technical bulletin on "Effect of long term application of organic and inorganic fertilizer on productivity and water use efficiency of pearl millet under rain fed condition". The bulletin will help to the concerned farmers using organic matter in the district as well as to the persons/ agencies involved in providing the guidance to the farmers in improving crop production in these problematic and resource constraint areas.

We are aware that water plays a vital role in agriculture crop production. Among other inputs i.e. seed, fertilizer, equipments, labour etc, the water conservation is also a alarming issue besides the scarcity of water for irrigation. It is difficult to change the scenario of available stored water, but it could be utilized efficiently by adopting the best management practices for the safe use of such water.

I congratulate to the authors for their concerted efforts in completing the task .i.e collection of data and analyzed the data and compilation of this work with beautiful spatial graphical portrait and its characteristics. I hope this technical bulletin will be useful for the beneficiaries to improve crop production in the dry land areas. This technical bulletin will also helpful to provide technical guidelines to formulate the cultivation strategies for proper management of dry land areas of Agra region as well as Utter Pradesh.

YUVRAJ AMBREESH PAL SINGH

PREFACE

Water is very precious for all living things, i.e. human being, animals, insects, plants etc. The climatic changes and low rain fall, frequent dry spells are the big challenges to the government, researchers, and farmers. Keeping these problems in view research field experiment "Effect of long term application of organic and inorganic fertilizer on productivity and water use efficiency of pearl millet under rain fed condition" has been carried out and compiled the data in a way to understand the importance of organic farming in dry land areas produced more grain yield and higher net profit and B: C ratio. This bulletin will be guideline for farmers. Policy makers, planners and help to the researchers, students and teachers for further study of these important aspects in the future.

We are heartily grateful to Dr. S.P.Madnawat , principal R.B.S College, Agra For encouraging and applauding the work and providing the logistic support and facilities for conducting the work and preparation of this bulletin.

We are very thankful to all those agencies/resource persons who helped us by providing required information timely and also thanks to the project staff for their support in preparing this manuscript.

At last but not the least. We are very thankful to the Indian Council of Agricultural Research for entrusting this important task and financial support to this AICRP for conducting the research on organic farming system.

Authors

1. INTRODUCTION

Agra centre of All India coordinated Research Project for Dry land Agriculture is running since September 1970 as a sub-centre at RBS College Bichpuri Agra and project is in operation at same location since inception. The centre is represent south-western part of U.P. i.e. Agra, Aligarh, Mathura, Mainpuri, Firozabad, Etah and Hathras. The major emphasis of the center was to develop more appropriate and suitable technology for better crop production under rain fed and moisture stress conditions of Agra region in the light of modern agriculture policies. Scientists working in the project have developed excellent research information leading to perfection of technologies which found place in package of practices of crop production in rain fed area of Agra region.

Uttar Pradesh is India's fourth largest and most populous state. The important rivers that flow through this state are Ganga and Yamuna. Eastern Uttar Pradesh is surrounded by Bihar, South part of the state is surrounded by M.P., on the west by Rajasthan, Delhi, Himachal and Haryana, and on the north by Uttarakhand. The north border of U.P. is surrounded by Nepal. The state is situated at latitude of 24^0 to 31^0 North and longitude of 77^0 to 84^0 east.

On the basis of 2011 census, the total population of the state is about 199 million, which is the 16.49 % of the total population of the country. The population density is 1187 person/sqkm. The literacy percentage is 77.3 in case of male and 57.2 % in case of female. The total area of the state is 2,36,286 Sq.km. Majority of people depends on farming . Wheat, rice, sugarcane, pulses, oil seeds and potato are the main crop grown here. About 12.8% of the geographical area of the state is under forest.

On the basis of rainfall pattern and soils, Uttar Pradesh divided into nine agro-climatic zones viz. Tarai, Western Plain, Mid western plain, South western semi arid plain, Central Plain, Bundelkhand, North western plain, Eastern Plain, and Vindhyan. The zone-wise analysis revealed that six out of nine possess better irrigation facilities and soil fertility status, where wheat-rice sugarcane cropping system are most popular and remaining three zones viz South-Western, Semi-arid zone, Bundelkhand and Vindhyan zones possess low irrigation facilities and soils are also average to medium in fertility and contributing major share of pulses and oilseed production. Major limitation of this agro-climatic zone are sodic soil in central plain, Brackish water, alkalinity or undulating ravines and rain fed situation in South-western semi-arid zone, Flood prone area in North-eastern plain, saline and alkaline soil and diara land in eastern plain, undulating and rocky area in Vindhyan zone.

Pearl millet (Pennesetum glaveum) is one of the important millet crop of hot and dry areas of arid and semi-arid climatic condition. It has been estimated that pearl millet embodies a tremendous productivity potential particularly in areas having extreme environmental stress condition on account of drought. Pearl millet grain is more nutritious with high protein of good quality. The grain contains 11-19 per cent protein, 60-78 per cent carbohydrates and 3.0-4.6 per cent fat good amount of phosphorus and iron . India is one of the main producers of pearl millet .It is a dual purpose crop of arid and semi-arid areas as it provides cheep food comparatively rich in various nutrients, protein, fat carbohydrates and minerals for poor masses and feed for poultry ,birds as well as green fodder for cattle .

In spite of being a C4 plant its average productivity in U.P. is around 14.00 q ha^{-1}. However, with good management including use of high yielding varieties, 35-40 q ha^{-1} yields can be obtained. The main reasons of low productivity of this crop in the state are moisture and nutritional stress.

In India, intensive agriculture using exhaustive high yielding fertilizer responsive varieties of crops has led to heavy withdrawal of nutrients from the soil during past few years and fertilizer

consumption remained much below in comparison to removal. This gap between nutrient removal and supply cannot be bridged by fertilizer alone. It can be achieved by integrated nutrient supply, using organic manures in conjunctive with fertilizer. Increased uses of chemical fertilizers without adequate organic recycling had not only aggravated multi nutrient deficiencies in soil plant system but also deteriorated, soil heath and created environmental pollution. Moreover, chemical fertilizer is becoming costlier input in agriculture. Therefore, it is right time to evaluate the feasibility and efficiency of organic manures for improving and building up of soil fertility. FYM has been advocated as good organic manure for use in integrated management practices in the field crops.

Several problems including soil fertility deterioration and environmental pollution emerging as a result of present agricultural system are affecting the soil productivity adversely. It is well known fact that addition of organic manures has shown considerable increase in crop yield and exerts significant influence on physical, chemical and biological properties of soil.FYM may be used to supplemental nutritional need of crop bends use of chemical fertilizer can be supplemental with NPK fertilizers. Although it is costlier than chemical fertilizer on nutrient basis but other beneficial effects, which it has on soil, can compensate for the added cost. FYM not only provides a variety of plant nutrients but also improves soil structure by its binding effect on soil aggregates. It increases cation exchange capacity, water holding capacity and nutrient availability in soil. The fertilizer use efficiency and microbial activity in soil are also improved.

The organic matter content of soil of this tract is low due to high temperature and light texture of soil. Application of organic matter has been reported to improve the physical condition and the water holding capacity besides supplying nutrients to the crops. Positive response of pearl millet to applied farm yard manure has been reported by several workers but no work has been reported on the effect of vermicompost in pearl millet.

Recycling of agricultural and industrial waste and utilization in agriculture as an alternative to fertilizer is promising Integrated use of chemical fertilizer with organic has been found to be quite promising in maintaining high productivity and greater stability for crop production. Vermicompost improves microbial load in soil and increase microbial availability of phosphorus in soil and increase microbial availability of phosphorus and nitrogen .Green revolution in India with eased phenomenal increase in fertilizer consumption and it may not be desirable to spared huge sum money towards the important fertilizer. More-over, the present hike in the prices of chemical fertilizer has compelled the farmers of the country to resort to imbalance nutrition for their crop and thus reduction in crop yields. At this critical juncture, there is an urgent need to optimize nutrient recycling to sustain crop production without affecting soil health and protecting the environment

The role of soil organic matter is well established in governing the improvement in soil physical, nutrient fluxes, microbial biomass and chemical properties. The use of inorganic fertilizer in combination with organic manure has been found more advantageous than either of them on their own for suitable agriculture for long-term basis. Application of FYM increased the organic C, macro and micro nutrients content of soil. Long term experiments are valuable tools for determine yield trend, understanding changes in yield, estimating nutrient dynamics, and assessing system sustainability. Realizing the importance of all these consideration, the present investigation “Effect of long term application of organic and inorganic fertilizer on productivity and water use efficiency of pearl millet under rain fed condition” in AICRPDA, sub center Agra was conducted about more than three decades this experiment and complied this documentation form in as a technical bulletin.

2. GENERAL FEATURES OF STUDY SITE

2.1 Site Characteristics

2.1.1 Location

AICRPDA Agra centre is located in agro-ecological sub region 4.1 (North-south and central high lands including aravallies) part of Indo-Gangetic alluvial plain at latitude of 27.0^{o}C north and longitude of 77.9^{o} East at an alleviation of about 163.4, above mean sea level. The field experiment were carried out for thirty four years (1984 to on going 2018) at Research Farm of All India Co-ordinated Research Project for Dry land Agriculture, Raja Balwant Singh College of Agriculture, Bichpuri, Agra, Uttar Pradesh - India

2.1.2 Climate

The agro climate of Agra is characterized by semi-arid sub-tropical with dry scorching heat waves in summer and severe cold in winter. The climate becomes very hot during May and June, which is followed by monsoon happening somewhere after September. Monsoon in the region is quite unpredictable, where you cannot predict which way it will turn. In summer, temperature raises up-to 48^{0}C with desiccating winds. May and June are considered to be hottest months of the year. The heat waves come from Rajasthan are immensely hot and need to take proper care. The average value of potential-evapo-transpiration (PET) is about 1850 mm; it is too excess than the precipitation (665 mm). The average value of PET is 5.05 mm/day with a maximum of 10.7 mm/day in the month of June and minimum of 2.13 mm/day in the month of January

In comparison to summer, winter is short, started from end of November to February. The cold waves from the Himalaya region makes the winter cold in the region. Temperature falls down as low as 0.5^{0}C or occasionally o^{0}C at the peak of winter. Generally, in the month of January dense fog experienced, by which visibility reduced on the roads.

2.1.3 Rainfall

The rainfall in this tract is quite unpredictable, highly erratic, uncertain, in-adequate, therefore its amount, distribution and intensity during crop growth period is highly important. The Rainfall in this tract is received from South-Western monsoon. The probable onset of monsoon is first week of July and it recedes up to third week of September. The average annual rainfall is about 665 mm (mean of 40 years) most of which (589 mm) is received during monsoon season (June to September). Out of 589 mm rainfall, 51.5 mm in June (8.7%), 238 mm in July (40.5%), 209 mm in August (35.5%) and 89.8 mm in September (12.5%) received. In winter season about 8 per cent of the total rainfall is registered. However, drought occurs ephemerally in early season (seeding stage), mid season (ground growth stage) or termination (flowering to grain filing stage) of the season twice in five years. The average number of rainy days in kharif season is about 35 to 40. The fig.1,2 and 3 show that actual rain fall (mm) and rain fall during crop growth in different years of experimentation on pearl millet crop grown under dry land condition of AICPRDA-Agra.

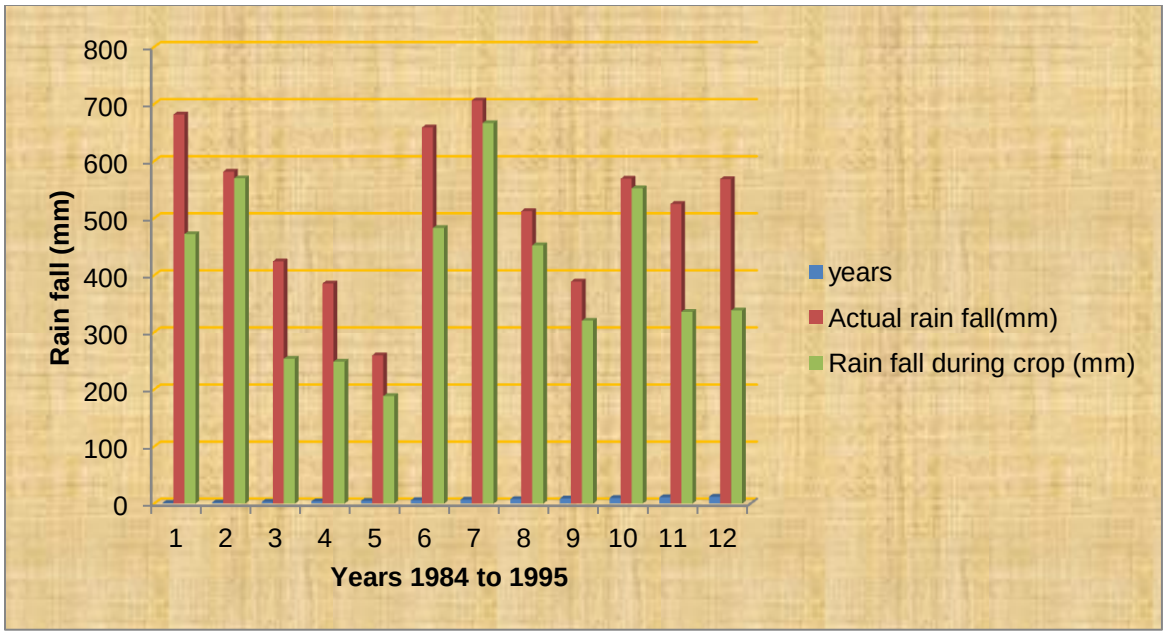

Fig-1: Rain fall (mm) during 1984 to 1995

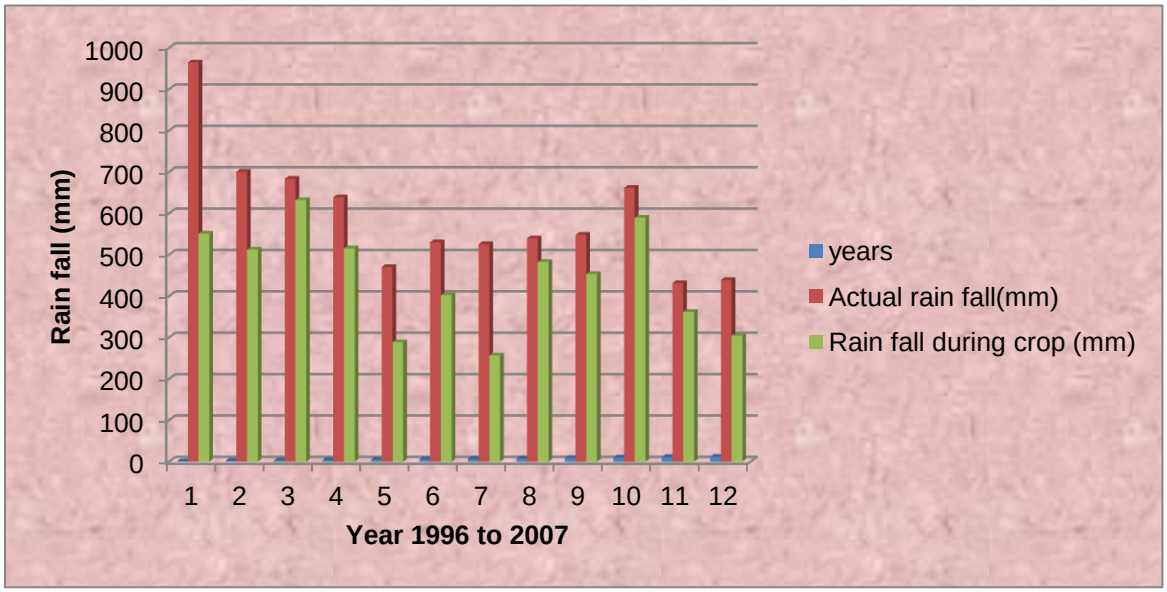

Fig 2: Rain fall During 1996 to 2007

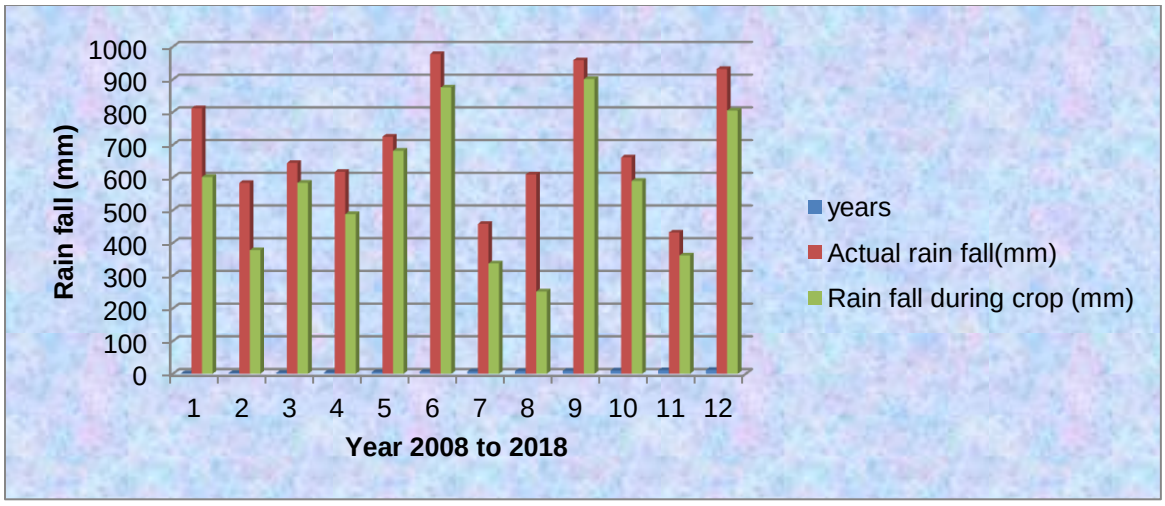

Fig 3: Rain fall during 2008 to 2018

2.1.4 Air temperature

May and June are the hottest months and mid December to January is the coldest period with a minimum temperature of 0.5 to 1.5^{0}C. Temperature gradually increase from February and reaches up to 48^{0}C in June.

2.1.5 **Relative humidity**

There is a large variation in relative humidity values varies from 20 to 98%, Higher values of mean relative humidity of 98 or 100% recorded in the month of August and lowest value of 15-20 per cent recorded in the month of May and June.

2.1.6 Potential Evapo-transpiration

The annual evaporation is about 1850 mm. The water required during kharif and Rabi range from 350 – 600 mm respectively.

2.1.7 Soil :

Soils of Agra region are predominantly, alluvial in origin and soils of the research area of dry land are light in texture varying from sandy loam to loamy sands in texture with an average composition of 64.6% sand, 21.4% silt and 14% clay content. Calcium carbonate concretionary layer occurs at varying depth in patches which influencing the soil depth. Soil is low in fertility status i.e. low in available nitrogen (180-200 kg/ha) and potash (114 -140 kg/ha) and medium in phosphorus (20-25 kg /ha). The physico chemical analysis of the soil (1:2 soil water ratio) reveals that pH of the soil varies from 7.8 to 8.5, but soil do not exhibit any salinity and alkalinity hazards. Electrical conductivity varies from 1.4 to 2.1 ds/m at 25^{0}C and hydraulic conductivity is 1.5 cm/hr. The bulk density ranges from 1.42 to1.48 g/cc. The mean values of Field capacity and permanent wilting point of one meter soil depth are 17.5 and 6.5 per cent, respectively. The water table in the area ranges between 18-19 meters in summer and 16-17 meter in rainy season. Water table gradually declined year after year. Because of exploitation of ground water in the form of excess irrigation and reducing the number and area of farm pond/community water tanks day by day, which are the major contributor in ground water recharge. On the other side, overflow of rain water increased which reduced the percolation of water in the soil. The table 1 clearly indicated that soil

properties of different physical, chemical different cat ions , an ions and available nutrients in different depth of soil in experimental site.

Table-1 Soil properties of the experimental field.

Soil parameter	Soil depth (cm)					
	0-20	20-45	45-72	72-115	115-140	140-180
1.Physical						
Textural class	Sandy loam	Loam	Clay loam	Clay loam	Silt loam	Fine lome
Hydrolic conductivity	1.15	0.646	0.602	0.602	0.814	1.81
Bulk density	1.45	1.52	1.52	1.51	1.44	1.42
2.Chemical						
pH	8.5	8.5	8.6	8.5	8.6	8.6
Ec (dS/m)	1.0	2.6	1.2	2.0	2.5	4.5
CEC(meq/100g soil)	12.8	12.6	14.4	14.8	14.8	14.8
ESP	13.59	13.49	11.93	11.46	12.34	12.34
Water Soluble Cat ions (meq/l)						
Ca	3.5	3.2	3.6	3.4	2.3	12.9
Mg	1.5	1.8	1.4	1.6	1.7	8.1
Na	5.1	20.2	7.3	4.9	190	28.6
K	0.10	0.15	0.15	0.20	0.18	0.10
Water Soluble An ions,(meq/l)						
Co3	-	-	-	-	-	-
Hco3	4.0	6.0	4.0	3.0	5.0	5.0
Cl	4.0	10.0	6.0	4.0	14.0	18.0
So4	2.4	9.2	2.6	2.8	6.3	21.8
Available Nutrients (kg/ha)						
N	198.2	92.1	128.6	10.4.4	79.5	61.2
P	16.2	8.8	11.2	17.4	7.2	7.2
K	112.0	69.6	112.0	89.6	78.4	76.6

2.1.8 Pre-dominant crops and cropping system :

AICRPDA centre of Agra represented South-western semi-dry Agro-ecological sub region of Uttar Pradesh (AESR 4.1.), which covers Agra, Aligarh, Etah, Firozabad, Hathras, Mathura and Mainpuri districts. In general, dry land area of Agra region is mono-cropped. Crops raised either in kharif season and leave the fields fallow in Rabi season or keep the land follow in kharif for in-situ moisture and raised crops in Rabi season on conserved soil moisture. The major kharif crops are pearl millet and Pigeon pea, besides Sorghum for fodder, sesame, green gram, black gram, Cluster bean are also grown. In Rabi season wheat, mustard, barley chickpea & lentil are the pre-dominant crops of the zone. Wheat and potato are taken in the irrigated area.

2.1.9 Cropping system

Mono-cropping system in normal and below normal rainfall years.

Kharif crops – fallow

Fallow in kharif – Rabi crops (in conserved moisture)

2.1.10 Double cropping in above normal or late withdrawal of monsoon

Green gram / Black gram – mustard

Pearl millet + Cowpea (fodder) – mustard

Green manuring in kharif – mustard

2.1.11 Inter cropping system

Pearl millet + green gram/black gram	(2:1 row ratio)
Chickpea + mustard	(4-5: 1)
Chickpea + lentil	(4:1)
Barley + Chickpea	(3:2)
Pigeon pea + green gram	(2:2)
Cluster bean + pearl millet / sesame	(6:1)
Linseed + mustard	(4:1)
Chickpea + linseed	(6:1)
Linseed + mustard	(4:1)
Chickpea + linseed	(6:1)

2.2 Problems and strategies to improve

- Soils of the region are incept sols, which are sandy loam to loamy sand with pH of 7.8 to 8.5 and low in organic matter
- Dry land soils are low in fertility status, higher response to applied nutrients, imbalanced fertilization, deficiency of micro-nutrients resulting poor yield potentials
- Ground water table is depleting at an alarming rate, mainly due to over exploitation of ground water, which is saline to alkaline in nature commonly applied in cereal crops during *rabi* season.
- Ground water of the area is saline in nature and about 70% ground water is not suitable for growing pulses and oilseeds.
- Numbers and area of natural reservoir /community tanks reducing day by day, which are the major contributors of ground water recharge. On the other side, overflow of rain water increased which reduced the percolation of water in the soil.
- Small size of holding and scattered ownership, farmers can not adopt individually rain water management techniques with special reference to farm pond technology.
- Rainfall pattern of area is, highly erratic, lead to failure and success of crop due to this fact, crop may suffer moisture stress at any stage of growth in each and every year, resulting poor yield.
- Lack of accurate forecasting of rains.
- Mostly varieties evolved for irrigated conditions, they are also recommended for Dry land conditions hence some time its failed.
- Most of the varieties performed better in normal season, but they are not suitable for aberrant weather conditions especially during late *kharif* season.
- Un-availability of agri.- equipments suitable for different agricultural operations for fragmented holding and inter cropping system etc.
- Farmers are well aware to the importance of line sowing, yet they could not follow this practice on their fields specially in *kharif* season, they are depend on hired machinery covering more area

in less time, It was felt that the machinery of agricultural operations should be available at least at the block or *panchayat* level.

- Sulphur has been recommended for mustard cultivation, covering about 80-85 thousand hectares, yet S containing fertilizer i.e. Ammonium sulphate or SSP is not supplied to the region, resulting stagnation or decline in yield of this crop.
- Rainfall pattern of last 5-6 years has compelled the farmers to take mustard with one irrigation of saline water, Due to this fact, the pulse area is being diverted under wheat and potato crops.
- Sowing time of mustard as per recommendation is being shifted to early. Due to low as well as early withdrawal of monsoon.
- High temperature in case of early withdrawal of monsoon creates problems in germination of mustard seed, resulting poor germination or failure of crops.
- Existence of ***Blue bull*** is also severe problem for the pulse cultivation in the region, which is also responsible for diversion to cereals.
- Sprinkler irrigation is not getting proper response of farmers because the size of holding and initial investment is not affordable.
- Vegetable cultivation is an income generated system, but this is not adopted by the small and marginal farmers.
- At the peak time of agricultural operations, farmers of the region are facing labour problems severely. On the contrary, labour do not engage in regular employment in rural areas. Another fact with the rural youth is that they are not so laborious and hence they do not undertake any agricultural work for their livelihood.
- Migration of labour from rural area to urban area is also prevailing. In general the labours are unskilled and they do not possess any technical knowhow.

2.2.1 Strategies

- To select and develop suitable crop and their varieties and agronomic practices for increasing crop production per unit area under dryland conditions
- To evolve suitable cropping systems in view of climatic parameters
- To increase water intake rate and moisture storage capacity of soils and to increase the efficiency of stored moisture for crop production
- To evolve suitable soil moisture conservation practices that reduces soil erosion and runoff
- Development of soil fertility improvement and to determine the rate and the method of application for efficient use of fertilizer
- To develop the suitable alternate land use system
- Farmers participatory varietal selection need to be addressed in rainfed region
- Re-charging of bore well by soil & water conservation practice
- Refinement of pearl millet based cropping system for sustainable production

3. Methodology

Background information leading to the need of the experiment:

Part of the nitrogen requirement of the crop can be replaced by organic waste available on the farm or by FYM, this not only improving the soil texture and fertility but reducing the cost of production also.

Year of start: Kharif 1984 to continue

Objectives:

To evaluate the benefits of organic residue with and without inorganic fertilizer application on the crop production of pearl millet-pearl millet crop sequence

Treatment details (Imposition of treatments including source of material/ implement/method/stage (DAS) of the crop etc).

T1 Control
T2 Recommended dose of fertilizer (60 kg N + 40 kg P_2O_5/ha)
T3 Half of the recommended dose of fertilizer
T4 50% N of the recommended dose to meet through farm residue
T5 50% N of the recommended dose to meet through FYM
T6 50% N through fertilizer + 50% N through farm residue
T7 50% N through fertilizer + 50% N through FYM
T8 Recommended dose of fertilizer + Zinc as soil application (25 kg ZnSo4 kg/ha)
T9 Farmers method (10-15 kg N/ha)

Experimental design and no. of replications: Randomized Block Design

Replication: Four

Plot size (m^2): Gross; 10.0 m X 9.0 m (90.0 sq. m.)
Net; 9.0 m X 7.20 (64.8 sq. m)

Experimental layout:

R4 **R3**

T5	**R1** T1	T7	T6	**R2** T2	T8
T2	T9	T4	T1	T5	T9
T6	T3	T8	T7	T3	T4

T9	T6	T2	T2	T8	T5
T4	T3	T5	T9	T1	T3
T1	T7	T8	T4	T7	T6

R1 **R2**

Seed rate (kg/ha) **:** 5.0

Spacing: : (a) Row to row - 45 cm (b) Plant to plant - 15 cm

Note:

40 kg P_2O_5 applied through DAP & rest N was applied through urea. 50% N of RDF to meet through FYM/farm residue incorporated in the soil before one month of sowing.

4. Crop performance

The pearl millet crop growing kharif season in different years (1984 to 2018) more than three decades. The results of pearl millet grain, Stover, net profit (Rs/ha), Benefit-cost ratio (B:C ratio) and rain water use efficiency (kg/ha-mm) given below**:**

Table 1: Effect of different treatments on pearl millet crop

Treatment	**Year 1984**		
	Grain Yield (kg/ha)	**Stover Yield (kg/ha)**	**RW U E (kg/ha-mm)**
T1 Control	1401	4962	2.97
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	2377	6924	5.03
T3 Half of the recommended dose of fertilizer	1976	5743	4.18
T4 50% N of the recommended dose to meet through farm residue	1750	5150	3.71
T5 50% N of the recommended dose to meet through FYM	1877	5366	3.98
T6 50% N through fertilizer + 50% N through farm residue	2172	5911	4.60
T7 50% N through fertilizer + 50% N through FYM	2182	6229	4.62
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	2453	7068	5.19
T9 Farmers method (10-15 kg N^{-1})	1675	5102	3.55
SEm ±	95.0	88.0	--
CD at 5%	277	258	--
CV (%)	9.59	--	--
Actual Rainfall (mm) during the season	**681.8**	--	--
Rainfall (mm) during crop growth period	**472.2**	**--**	**--**

Application of the recommended dose of fertilizer (60kg N + 30 kg P_2O_5 ha^{-1}) to pearl millet crop either alone or with zinc (25 kg $ZnSo_4$ ha^{-1}) gave significant higher grain and Stover yield than that recorded with control, farmers method and 50 per cent recommended dose (Table 1& Fig 1). The difference in grain and Stover yield due to recommended dose of fertilizer and 50 per cent nitrogen through fertilizer + 50 per cent nitrogen through FYM were at par.

It is clear from the results that recommended dose of fertilizer is essential for maximum production of pearl millet. The 50 per cent nitrogen required to the crop may be given through FYM.

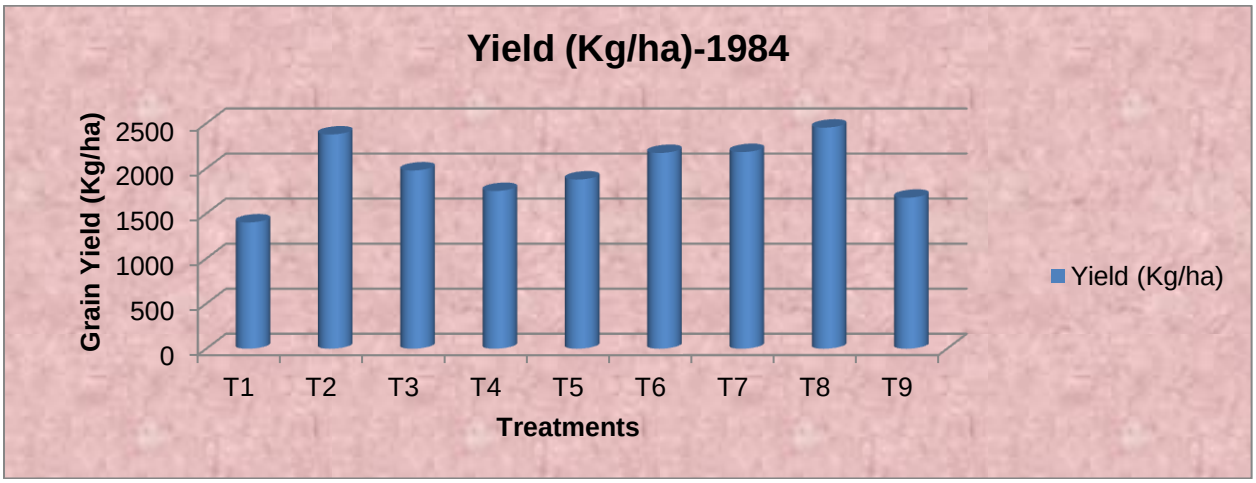

Fig 1: Pearl millet grain yield (kg/ha) in different treatments

Table 2: Monthly meteorological observations recorded at R.B.S. College, Bichpuri, Agra

Months	Temperature(0^C) Max.	Min.	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	20.7	5.6	92.0	-	2.2	2.2
February	22.6	8.2	81.4	-	2.4	2.3
March	38.5	14.5	58.7	-	2.8	2.8
April	36.9	15.7	56.3	-	5.9	3.1
May	44.7	21.5	40.8	3.0	8.5	3.4
June	41.5	26.4	62.0	44.5	9.1	3.5
July	35.7	25.2	85.2	89.0	6.3	3.8
August	33.2	24.2	90.3	204.4	4.0	3.6
September	31.8	21.1	89.2	157.6	3.8	3.0
October	32.5	13.3	75.8	-	4.3	1.8
November	27.2	8.0	89.8	-	3.1	2.1
December	22.2	4.0	86.3	-	2.1	2.3

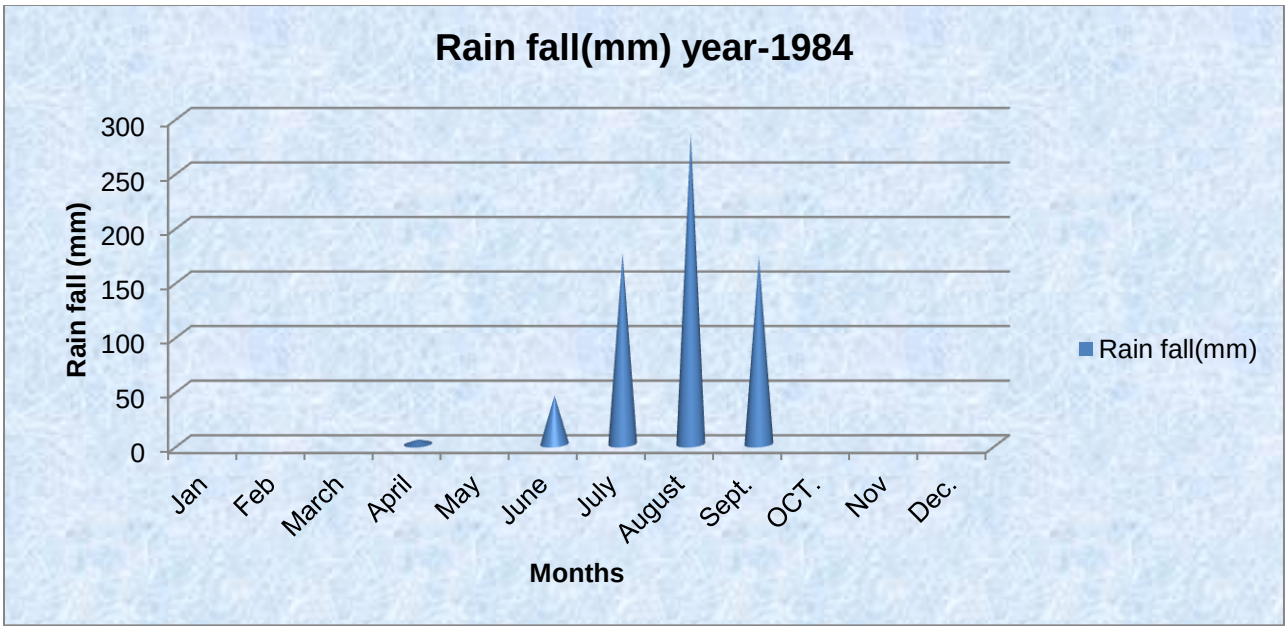

Fig 2 : Monthly rain fall distribution

Temperature minimum and maximum: In the year 1984 the maximum temperature varied from 20.7 to 44.7 ^{o}c and minimum was ranged from 4.0 to 26.4 ^{o}c .

Relative humidity (%): The relative humidity in the year 1984 varied from 40.8 to 92.0%.

Rain fall (mm): The total precipitation in the year 1984 was recorded 681.8 mm and in the crop growth period it was recorded 472.2 mm.

Evaporation: The evaporation in the year 1984 ranged from 2.1 to 8.5 mm/day.

Water table: The water table position during the period from January 1984 to December 1984 is presented in table 2. It was variable in different months and varied from 1.8 to 3.8 m.

Table 3: Effect of different treatments on pearl millet crop

Treatment	Year 1985		
	Grain Yield (kg/ha)	**Stover Yield (kg/ha)**	**RW U E (kg/ha-mm)**
T1 Control	963	4005	1.69
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	1863	6438	3.27
T3 Half of the recommended dose of fertilizer	1358	5243	2.38
T4 50% N of the recommended dose to meet through farm residue	1170	4523	2.05
T5 50% N of the recommended dose to meet through FYM	1320	5153	2.32
T6 50% N through fertilizer + 50% N through farm residue	1478	5278	2.59
T7 50% N through fertilizer + 50% N through FYM	1738	6325	3.05
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	1915	6750	3.36
T9 Farmers method (10-15 kg N^{-1})	1073	4360	1.88
SEm ±	76.0	162.0	--
CD at 5%	221	472.0	--
CV (%)	10.62	--	--
Actual Rainfall (mm) during the season	**581.6**	--	--
Rainfall (mm) during crop growth period	**570.0**	--	--

Application of the recommended dose of fertilizer (60kg N + 30 kg P_2O_5 ha^{-1}) to pearl millet crop either alone or with zinc (25 kg $ZnSo_4$ ha^{-1}) gave significant higher grain and Stover yield than that recorded with control, farmers method and 50 per cent recommended dose (Table 3 and fig.3). The difference in grain and Stover yield due to recommended dose of fertilizer and 50 per cent nitrogen through fertilizer + 50 per cent nitrogen through FYM were at par .

It is clear from the results that recommended dose of fertilizer is essential for maximum production of pearl millet. The 50 per cent nitrogen required to the crop may be given through FYM.

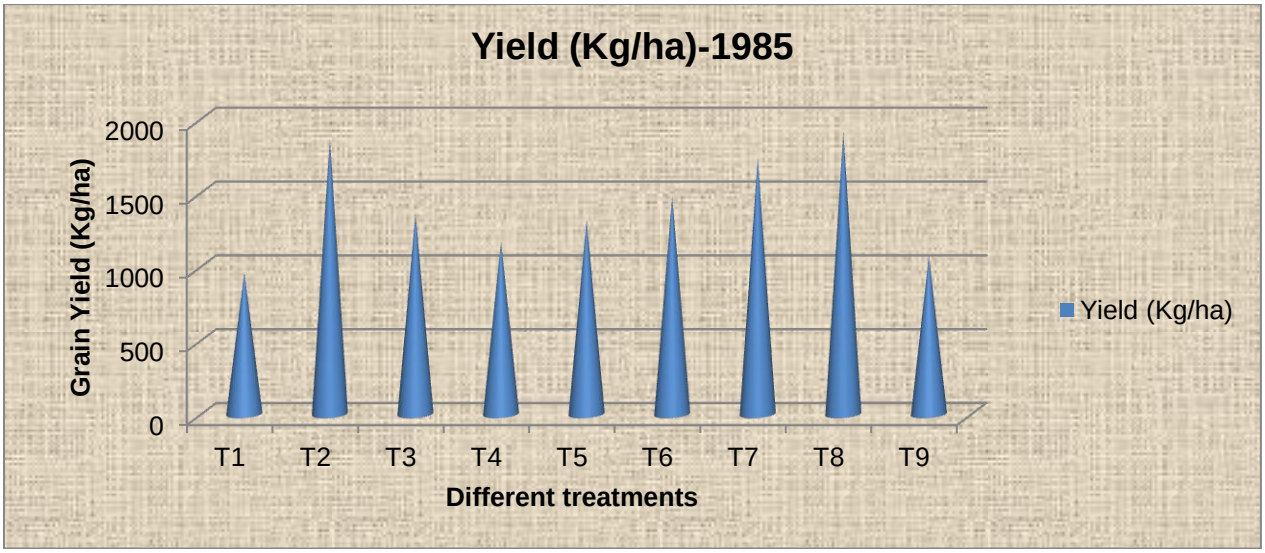

Fig 3: Pearl millet grain yield (kg/ha) in different treatments

Table 4: Monthly meteorological observations recorded at R.B.S. College , Bichpuri, Agra

Months	Temperature(0^C) Max.	Min.	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	17.8	3.8	95.8	21.2	2.1	2.7
February	24.2	3.3	80.4	-	3.5	3.2
March	31.3	9.4	67.5	5.1	5.0	3.5
April	37.3	17.1	47.8	14.4	7.9	3.7
May	42.0	22.9	48.0	-	11.0	3.8
June	40.0	26.2	63.5	17.0	10.6	3.5
July	31.9	23.2	93.0	319.4	5.8	4.5
August	31.6	23.1	89.4	157.0	4.3	3.4
September	30.7	20.3	94.3	81.0	4.5	3.1
October	27.7	15.4	93.8	101.2	3.2	3.4
November	26.8	8.4	93.3	-	2.8	3.1
December	20.8	6.4	92.8	11.8	2.1	3.3

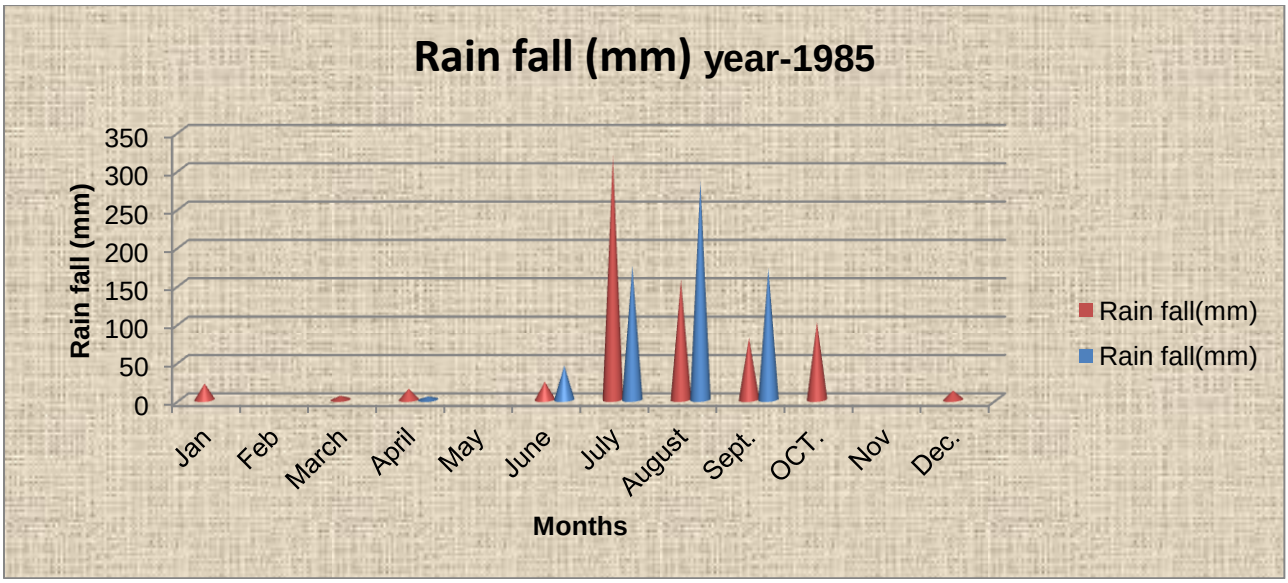

Fig 4: Monthly rain fall distribution

Temperature minimum and maximum: In the year 1985 the maximum temperature varied from 17.8 to 42.0 ^{o}c and minimum was ranged from 3.3 to 26.2 ^{o}c .

Relative humidity (%): The relative humidity in the year 1985 varied from 47.8 to 95.8%.

Rain fall (mm): The total precipitation in the year 1985 was recorded 581.6 mm and in the crop growth period it was recorded 570.0 mm.

Evaporation: The evaporation in the year 1985 ranged from 2.1 to 11.0 mm/day.

Water table: The water table position during the period from January 1985 to December 1985 is presented in table 4. It was variable in different months and varied from 2.7 to 4.5 m.

Table 5: Effect of different treatments on pearl millet crop

Treatment	Year 1986		
	Grain Yield (kg/ha)	**Stover Yield (kg/ha)**	**RW U E (kg/ha-mm)**
T1 Control	504	3053	1.99
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	1093	5179	4.30
T3 Half of the recommended dose of fertilizer	849	4528	3.34
T4 50% N of the recommended dose to meet through farm residue	639	4185	2.52
T5 50% N of the recommended dose to meet through FYM	798	4425	3.14
T6 50% N through fertilizer + 50% N through farm residue	819	4802	3.23
T7 50% N through fertilizer + 50% N through FYM	1069	5111	4.21
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	1144	5282	4.51
T9 Farmers method (10-15 kg N^{-1})	610	3842	2.40
SEm ±	58.0	171.0	--
CD at 5%	169	496.0	--
CV (%)	13.95	7.63	--
Actual Rainfall (mm) during the season	**424.4**	--	--
Rainfall (mm) during crop growth period	**253.9**	--	--

Application of the recommended dose of fertilizer (60kg N + 30 kg P_2O_5 ha^{-1}) to pearl millet crop either alone or with zinc (25 kg $ZnSo_4$ ha^{-1}) gave significant higher grain and Stover yield than that recorded with control, farmers method and 50 per cent recommended dose (Table 5fig 5). The difference in grain and Stover yield due to recommended dose of fertilizer and 50 per cent nitrogen through fertilizer + 50 per cent nitrogen through FYM were at par .

It is clear from the results that recommended dose of fertilizer is essential for maximum production of pearl millet. The 50 per cent nitrogen required to the crop may be given through FYM.

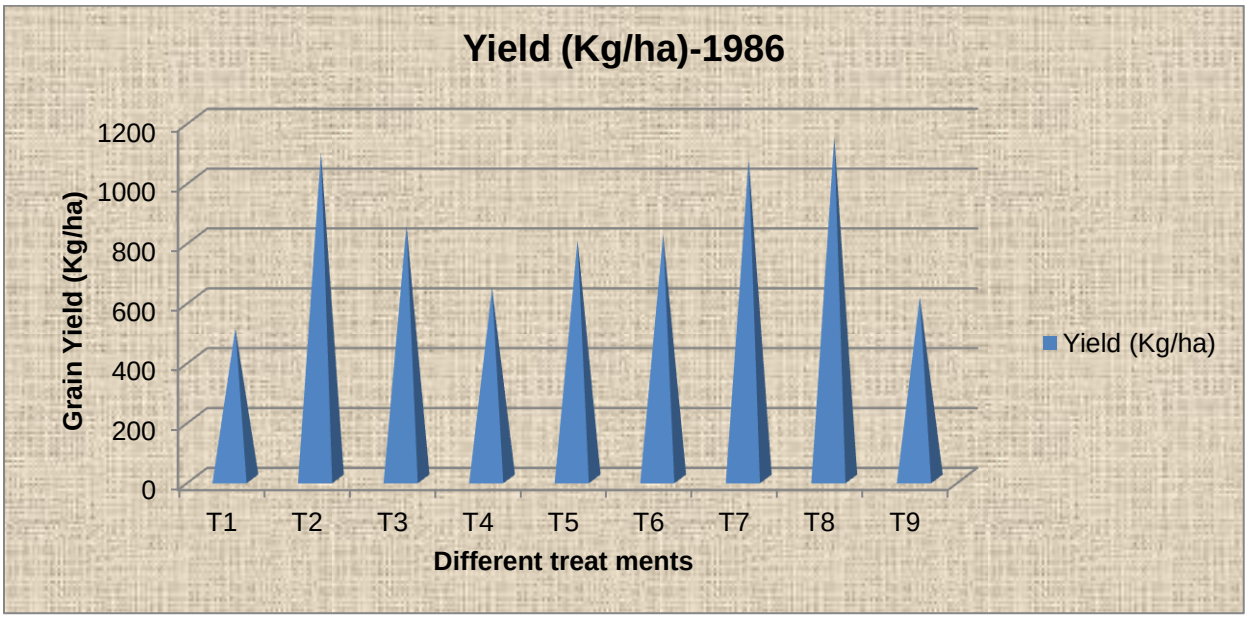

Fig 5: Pearl millet grain yield in different treatments

Table 6: Monthly meteorological observations recorded at R.B.S. College , Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	18.1	2.1	94.5	-	1.6	3.5
February	19.6	5.1	93.3	48.3	1.1	3.6
March	28.0	11.5	83.0	3.0	4.2	3.8
April	36.0	16.4	54.2	-	6.6	4.1
May	37.8	20.1	56.8	28.0	7.5	4.1
June	37.5	24.5	63.3	47.0	7.1	4.2
July	31.2	23.9	84.5	129.6	4.2	4.2
August	31.9	22.6	85.5	58.7	4.3	4.2
September	34.0	20.1	75.2	62.6	5.4	4.4
October	30.5	14.7	83.8	45.0	3.5	4.5
November	26.3	8.5	83.0	-	2.7	4.7
December	18.1	2.6	88.0	2.2	1.7	4.9

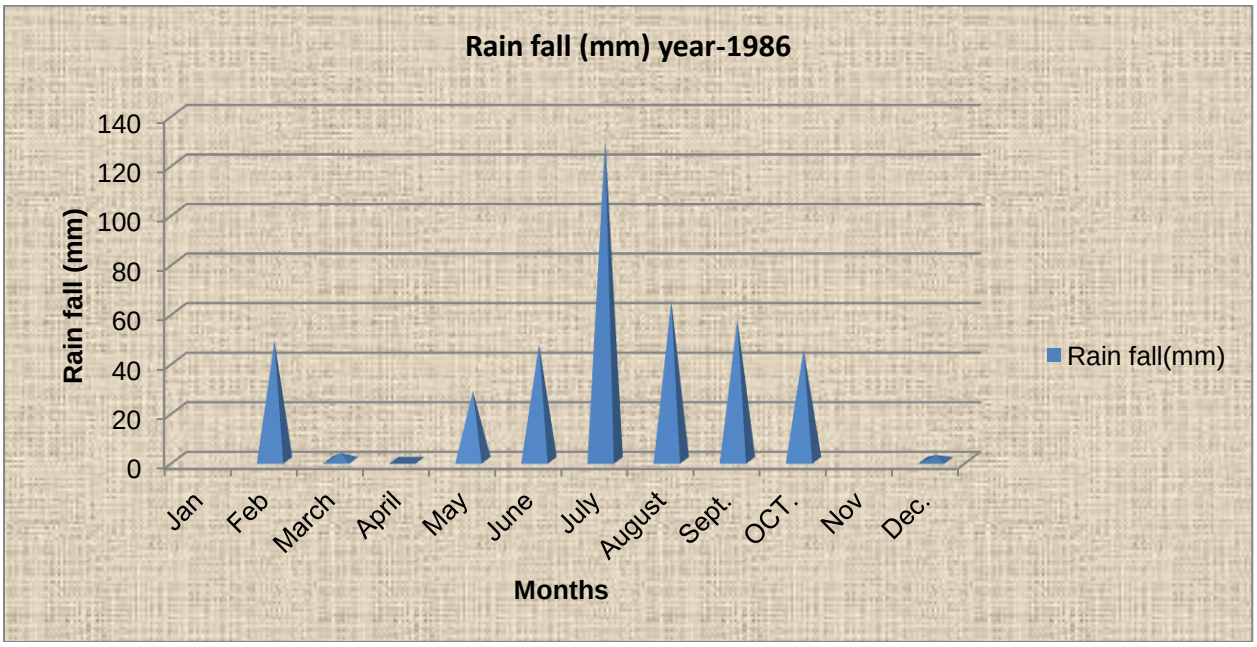

Fig 6: Monthly rain fall distribution

Temperature minimum and maximum: In the year 1986 the maximum temperature varied from 18.1 to 37.8 ^{o}c and minimum was ranged from 2.1 to 24.5 ^{o}c .
Relative humidity (%): The relative humidity in the year 1986 varied from 54.2 to 94.5%.
Rain fall (mm): The total precipitation in the year 1986 was recorded 424.4 mm and in the crop growth period it was recorded 253.9 mm.
Evaporation: The evaporation in the year 1986 ranged from 1.1 to 7.5 mm/day.
Water table: The water table position during the period from January 1986 to December 1986 is presented in table 6. It was variable in different months and varied from 3.5 to 4.9 m.

Table 7: Effect of different treatments on pearl millet crop

Treatment	Year 1987		
	Grain Yield (kg/ha)	Stover Yield (kg/ha)	RW U E (kg/ha-mm)
T1 Control	--	1005	--
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	--	1505	--
T3 Half of the recommended dose of fertilizer	--	1226	--
T4 50% N of the recommended dose to meet through farm residue	--	1065	--
T5 50% N of the recommended dose to meet through FYM	--	1186	--
T6 50% N through fertilizer + 50% N through farm residue	--	1386	--
T7 50% N through fertilizer + 50% N through FYM	--	1476	--
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	--	1526	--
T9 Farmers method (10-15 kg N^{-1})	--	1046	--
SEm ±	--	--	--
CD at 5%	--	--	--
CV (%)	--	--	--
Actual Rainfall (mm) during the season	**409.8**	--	--
Rainfall (mm) during crop growth period	**188.4**	--	--

This year severe drought was observed and no grain yield was found but only stover yield was observed in the experiment and given in table 7and fig 7. The maximum stover yield was observed in T8 and minimum in T1 control treatment

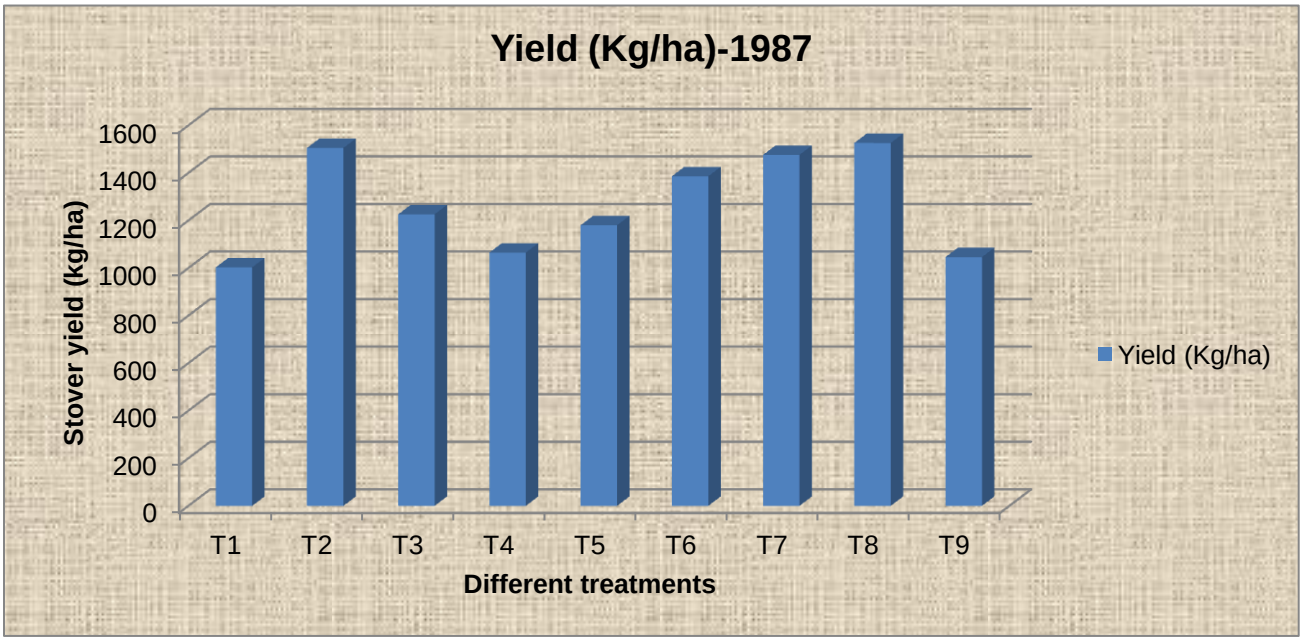

Fig 7: Pearl millet Stover yield in different treatments.

Table 8: Monthly meteorological observations recorded at R.B.S. College, Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	12.3	2.8	89.5	1.0	1.5	5.1
February	23.7	5.4	86.5	5.6	2.9	5.3
March	27.2	9.6	81.5	1.6	4.6	5.4
April	36.6	15.4	52.6	-	8.4	5.3
May	37.7	19.2	64.3	44.4	7.8	5.3
June	41.5	25.2	50.5	19.0	10.8	5.3
July	38.5	24.2	62.6	93.6	8.8	5.8
August	37.1	24.0	75.0	129.6	6.5	6.4
September	31.8	21.2	83.3	59.6	3.9	6.4
October	32.7	14.9	75.4	5.4	5.1	6.5
November	26.7	7.1	92.8	-	8.1	6.9
December	19.4	3.0	95.8	15.0	5.9	7.3

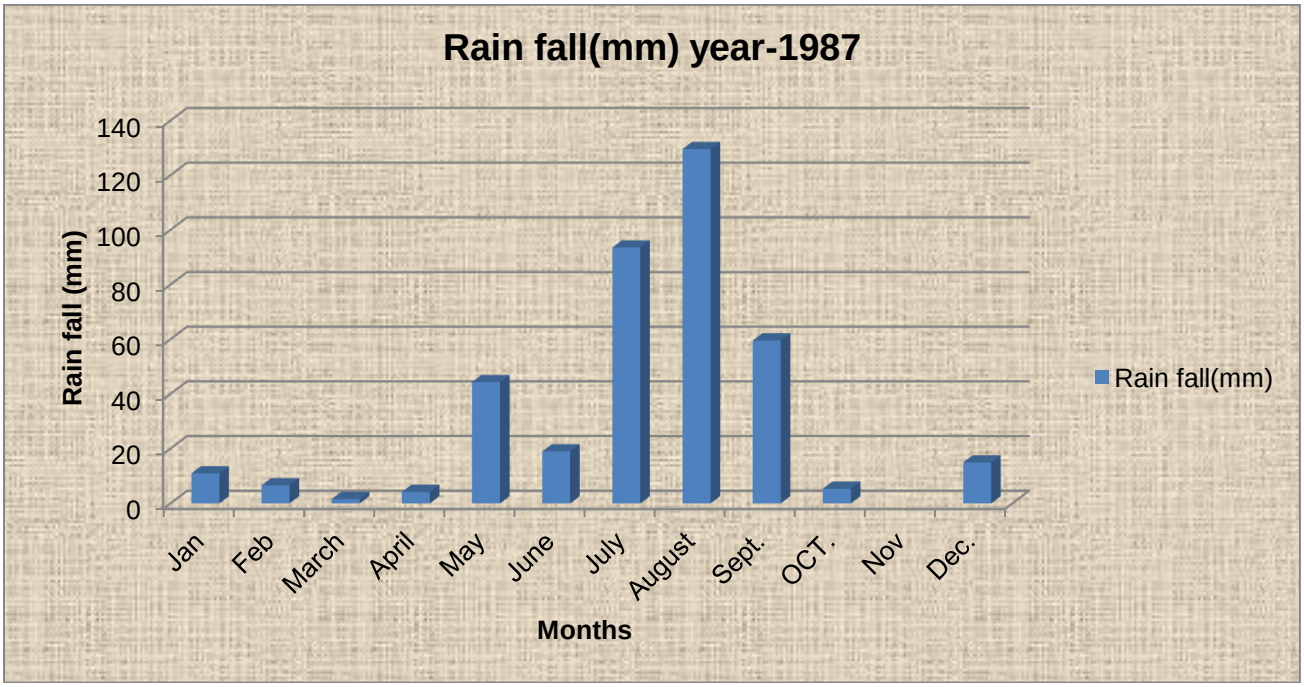

Fig 8 Monthly rain fall distribution

Temperature minimum and maximum: In the year 1987 the maximum temperature varied from 12.3 to 41.5 ^{o}c and minimum was ranged from 2.8 to 25.2 ^{o}c .
Relative humidity (%): The relative humidity in the year 1987 varied from 50.5 to 95.8%.
Rain fall (mm): The total precipitation in the year 1987 was recorded 409.8 mm and in the crop growth period it was recorded 188.4 mm.
Evaporation: The evaporation in the year 1987 ranged from 1.5 to 10.8 mm/day.
Water table: The water table position during the period from January 1987 to December 1987 is presented in table 8. It was variable in different months and varied from 5.1 to 7.3 m.

Table 9: Effect of different treatments on pearl millet crop

Treatment	Year 1988		
	Grain Yield (kg/ha)	**Stover Yield (kg/ha)**	**RW U E (kg/ha-mm)**
T1 Control	990	5384	2.05
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	1521	7390	3.15
T3 Half of the recommended dose of fertilizer	1206	6811	2.50
T4 50% N of the recommended dose to meet through farm residuue	1185	6838	2.45
T5 50% N of the recommended dose to meet through FYM	1196	6877	2.48
T6 50% N through fertilizer + 50% N through farm residue	1351	7051	2.80
T7 50% N through fertilizer + 50% N through FYM	1441	7320	2.98
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	1576	7424	3.26
T9 Farmers method (10-15 kg N^{-1})	1055	6250	2.18
SEm ±	68.0	251.0	--
CD at 5%	199	730.0	--
CV (%)	10.65	7.39	--
Actual Rainfall (mm) during the season	**659.0**	--	--
Rainfall (mm) during crop growth period	**483.1**	--	--

Application of the recommended dose of fertilizer (60kg N + 30 kg P_2O_5 ha^{-1}) to pearl millet crop either alone or with zinc (25 kg $ZnSo_4$ ha^{-1}) gave significant higher grain and Stover yield than that recorded with control, farmers method and 50 per cent recommended dose (Table 9& fig 9). The difference in grain and Stover yield due to recommended dose of fertilizer and 50 per cent nitrogen through fertilizer + 50 per cent nitrogen through FYM were at par .

It is clear from the results that recommended dose of fertilizer is essential for maximum production of pearl millet. The 50 per cent nitrogen required to the crop may be given through FYM.

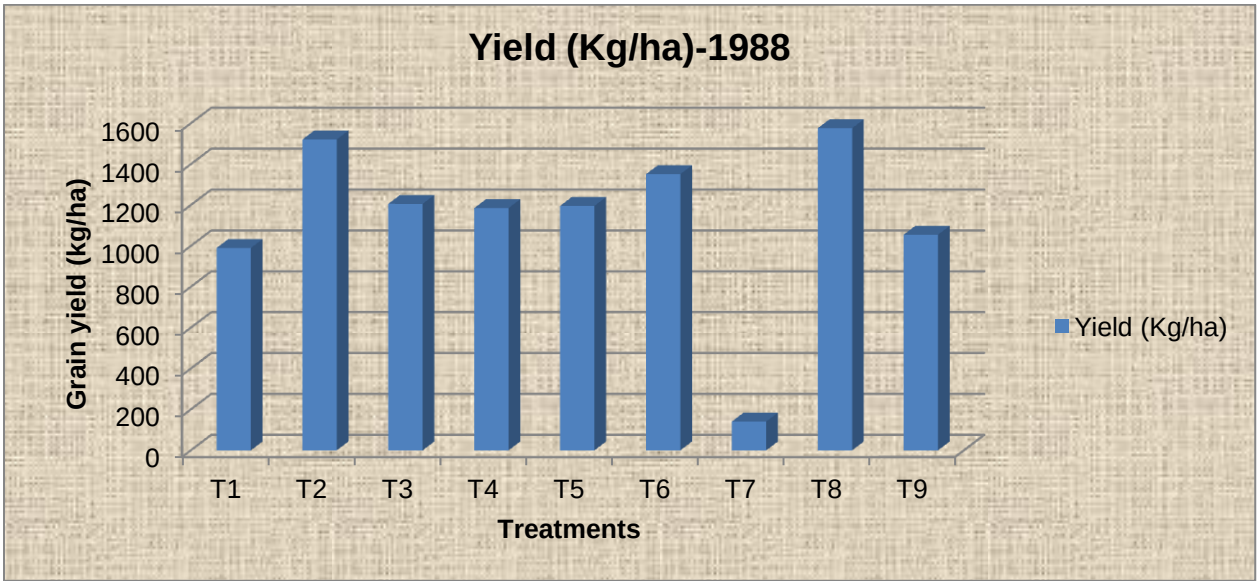

Fig 9: Pearl millet grain yield of different treatments

Table 10:Monthly meteorological observations recorded at R.B.S. College, Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	18.4	2.6	93.8	9.2	1.8	7.3
February	22.2	4.9	85.8	-	3.3	7.4
March	28.3	10.2	88.3	11.4	5.9	7.6
April	39.0	21.7	68.8	-	8.9	7.6
May	43.8	29.5	43.0	8.4	9.7	7.7
June	38.3	26.5	63.5	86.2	8.3	7.8
July	32.8	22.8	90.0	284.4	3.5	7.5
August	32.1	25.3	90.8	350.5	3.2	7.1
September	35.2	24.9	82.3	23.4	4.8	6.4
October	33.2	17.1	86.2	29.4	3.5	6.5
November	28.3	10.8	87.5	-	2.6	6.7
December	22.4	7.6	95.3	-	1.6	6.9

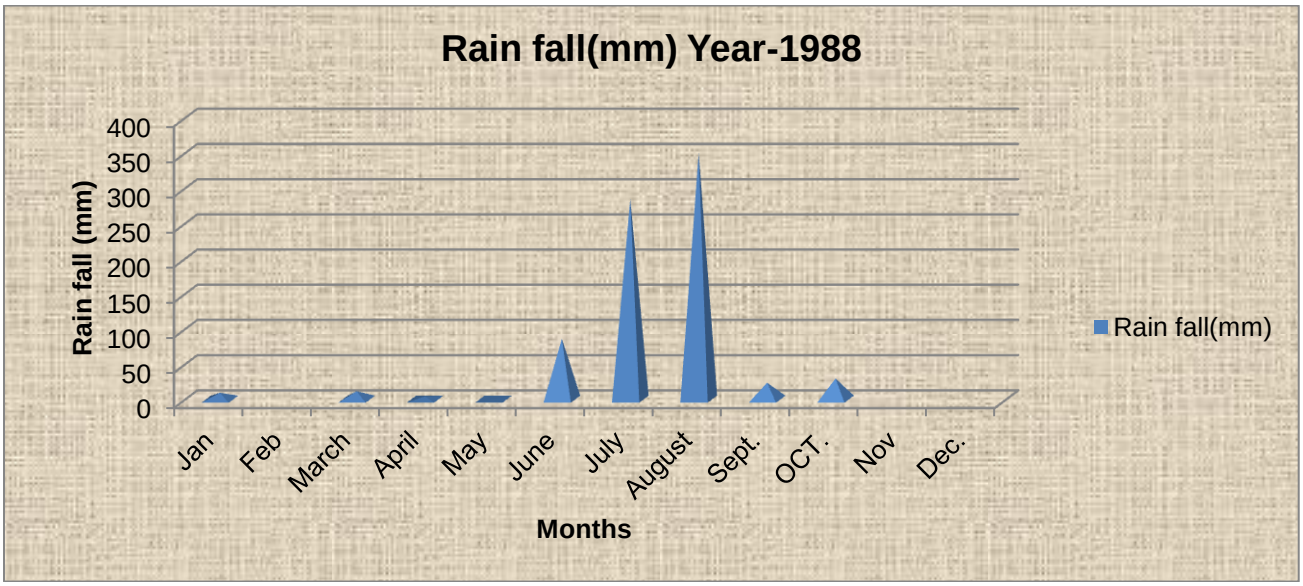

Fig 10: Monthly rain fall distribution

Temperature minimum and maximum: In the year 1988 the maximum temperature varied from 18.4 to 43.8 ^{o}c and minimum was ranged from 2.6 to 29.5 ^{o}c .

Relative humidity (%): The relative humidity in the year 1988 varied from 43.0 to 95.3 %.

Rain fall (mm): The total precipitation in the year 1988 was recorded 659.0 mm and in the crop growth period it was recorded 483.1 mm.

Evaporation: The evaporation in the year 1988 ranged from 1.8 to 9.7 mm/day.

Water table: The water table position during the period from January 1988 to December 1988 is presented in table 10. It was variable in different months and varied from 6.4 to 7.8 m.

Table 11: Effect of different treatments on pearl millet crop

Treatment	Year 1989		
	Grain Yield (kg/ha)	**Stover Yield (kg/ha)**	**RW U E (kg/ha-mm)**
T1 Control	783	3673	1.17
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	1790	7893	2.68
T3 Half of the recommended dose of fertilizer	1157	5190	1.74
T4 50% N of the recommended dose to meet through farm residue	998	4736	1.50
T5 50% N of the recommended dose to meet through FYM	1111	4890	1.67
T6 50% N through fertilizer + 50% N through farm residue	1290	6044	1.93
T7 50% N through fertilizer + 50% N through FYM	1705	6730	2.56
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	1838	8004	2.76
T9 Farmers method (10-15 kg N^{-1})	912	4451	1.37
SEm ±	78.0	228.0	--
CD at 5%	228.0	839.0	--
CV (%)	12.37	10.02	--
Actual Rainfall (mm) during the season	**706.3**	--	--
Rainfall (mm) during crop growth period	**666.8**	--	--

Application of the recommended dose of fertilizer (60kg N + 30 kg P_2O_5 ha^{-1}) to pearl millet crop either alone or with zinc (25 kg $ZnSo_4$ ha^{-1}) gave significant higher grain and Stover yield than that recorded with control, farmers method and 50 per cent recommended dose (Table 11 & fig 11). The difference in grain and Stover yield due to recommended dose of fertilizer and 50 per cent nitrogen through fertilizer + 50 per cent nitrogen through FYM were at par .

It is clear from the results that recommended dose of fertilizer is essential for maximum production of pearl millet. The 50 per cent nitrogen required to the crop may be given through FYM.

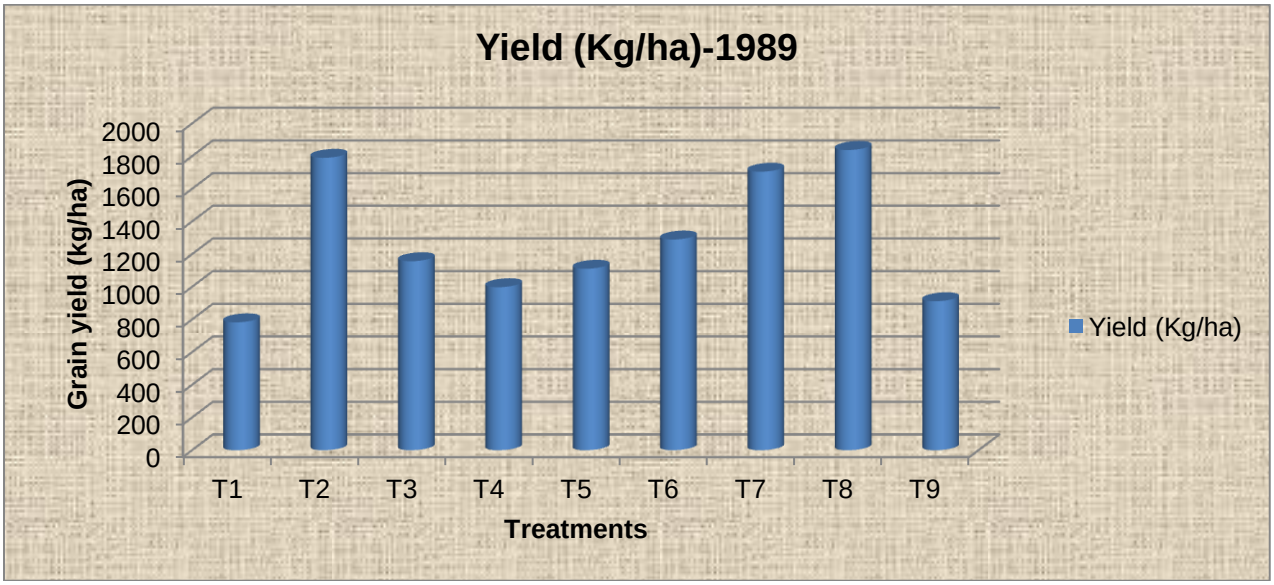

Fig 11: Pearl millet grain yield of different treatments

Table 12:Monthly meteorological observations recorded at R.B.S. College ,Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	20.9	4.9	90.2	12.0	1.8	7.0
February	24.6	7.4	80.6	-	3.4	7.1
March	30.6	14.2	78.3	10.2	5.5	7.2
April	37.4	18.5	41.8	-	10.5	7.3
May	32.4	25.3	38.5	-	14.1	7.4
June	38.6	27.5	59.5	14.6	9.9	7.4
July	35.5	26.7	77.6	153.5	6.1	7.5
August	33.2	25.5	89.3	189.2	4.1	7.1
September	33.7	24.5	87.5	335.6	4.7	5.9
October	34.4	17.1	73.8	-	5.1	6.0
November	29.4	11.0	87.5	-	3.5	6.3
December	21.7	6.3	95.0	3.2	1.6	6.5

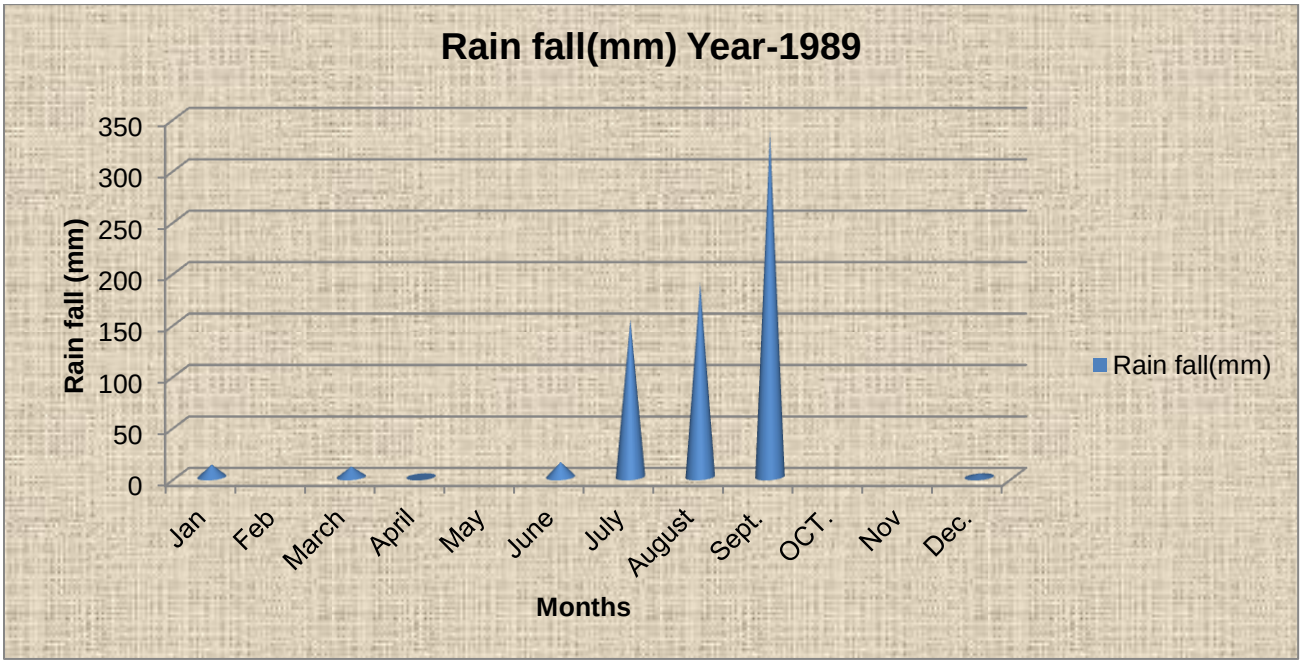

Fig 12 Monthly rain fall distribution

Temperature minimum and maximum: In the year 1989 the maximum temperature varied from 20.9 to 38.6 ^{o}c and minimum was ranged from 4.9 to 27.5 ^{o}c .

Relative humidity (%): The relative humidity in the year 1989 varied from 38.5 to 95.0%.

Rain fall (mm): The total precipitation in the year 1989 was recorded 706.3 mm and in the crop growth period it was recorded 666.8 mm.

Evaporation: The evaporation in the year 1989 ranged from 1.6 to 14.1 mm/day.

Water table: The water table position during the period from January 1989 to December 1989 is presented in table 12. It was variable in different months and varied from 5.9 to 7.5 m.

Table 13: Effect of different treatments on pearl millet crop

Treatment	Year 1990		
	Grain Yield (kg/ha)	Stover Yield (kg/ha)	RW U E (kg/ha-mm)
T1 Control	1250	3880	2.76
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	2453	6160	5.41
T3 Half of he recommended dose of fertilizer	1925	5050	4.25
T4 50% N of the recommended dose to meet through farm residue	1909	4840	4.21
T5 50% N of the recommended dose to meet through FYM	1977	5175	4.36
T6 50% N through fertilizer + 50% N through farm residue	2357	5612	5.20
T7 50% N through fertilizer + 50% N through FYM	2550	6465	5.63
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	2510	6270	5.54
T9 Farmers method (10-15 kg N^{-1})	1389	4155	3.06
SEM ±	126	256	
CD at 5%	367	972	
CV (%)	--	--	
Actual Rainfall (mm) during the season	**512.6**	--	--
Rainfall (mm) during crop growth period	**452.6**	--	--

The data on seed yield of pearl millet presented in table 13 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 2550 kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 5.63 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively**.**

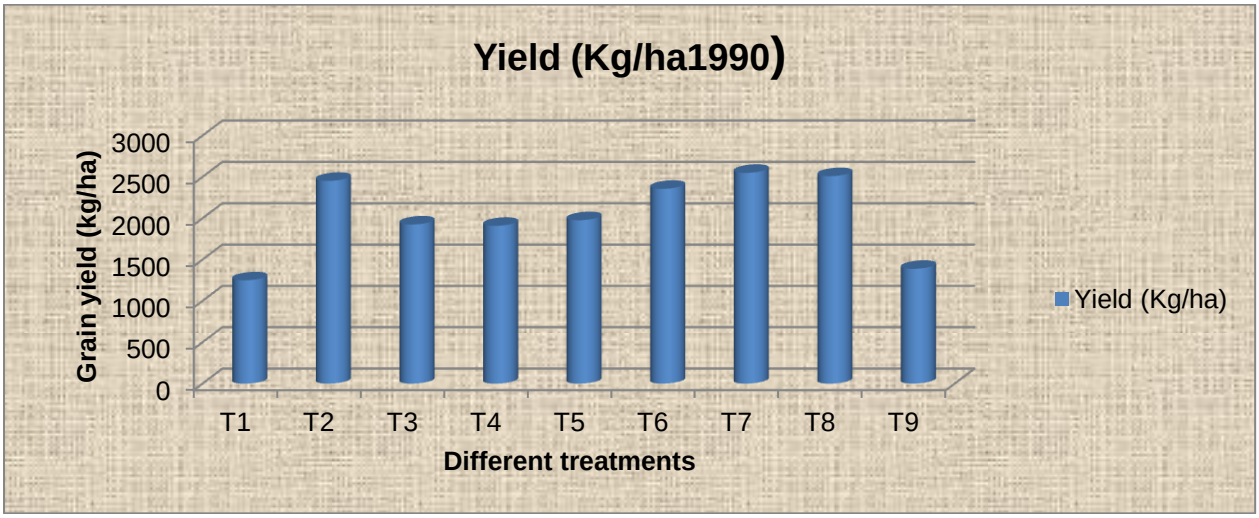

Fig 13 : Pearl millet grain yield in different treatments

Table 14:Monthly meteorological observation recorded at R.B.S. College , Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity (%)	Rainfall (mm)	Evaporation (mm/day)	Water table (m)
January	23.1	7.2	90.2	-	2.2	6.7
February	22.9	11.2	92.0	52.8	2.3	6.6
March	30.1	13.4	79.0	-	5.8	6.4
April	37.5	20.1	51.4	0.2	9.7	6.5
May	41.2	27.6	53.0	18.2	11.5	6.5
June	40.1	28.9	54.5	51.6	11.2	6.8
July	32.8	26.4	88.4	230.4	4.3	6.7
August	33.6	26.0	86.3	74.6	4.7	6.6
September	32.0	24.9	90.3	220.4	3.8	6.5
October	33.3	17.3	86.2	-	4.1	6.5
November	28.1	11.3	91.7	-	3.2	6.9
December	23.3	7.1	92.5	4.2	2.1	7.2

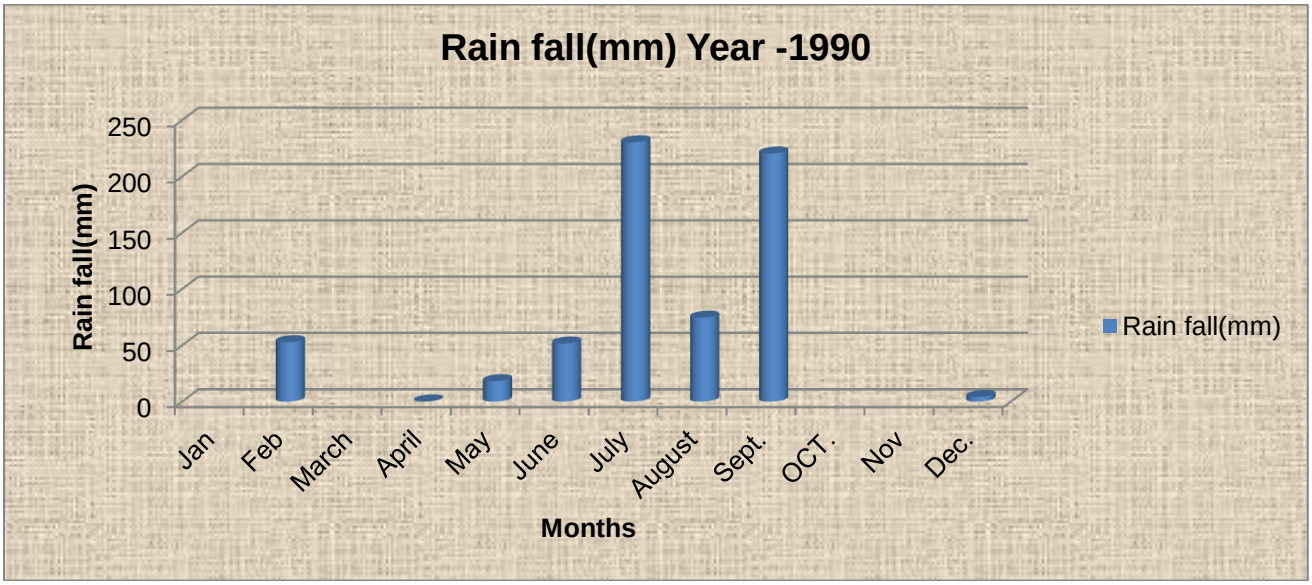

Fig 14: Monthly rain fall distribution

Temperature minimum and maximum: In the year 1990 the maximum temperature varied from 22.9 to 41.2 ^{o}c and minimum was ranged from 7.1 to 28.9 ^{o}c .

Relative humidity (%): The relative humidity in the year 1990 varied from 51.4 to 92.5 %.

Rain fall (mm): The total precipitation in the year 1990 was recorded 512.6 mm and in the crop growth period it was recorded 452.6 mm.

Evaporation: The evaporation in the year 1990 ranged from 2.1 to 11.5 mm/day.

Water table: The water table position during the period from January 1990 to December 1990 is presented in table 14. It was variable in different months and varied from 6.4 to 7.2 m.

Table 15: Effect of different treatments on pearl millet crop

Treatment	Year 1991		
	Grain Yield (kg/ha)	**Stover Yield (kg/ha)**	**RW U E (kg/ha-mm)**
T1 Control	1018	4230	3.17
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	1842	8412	5.74
T3 Half of he recommended dose of fertilizer	1491	6362	4.65
T4 50% N of the recommended dose to meet through farm residue	1590	6770	4.95
T5 50% N of the recommended dose to meet through FYM	1757	7430	5.48
T6 50% N through fertilizer + 50% N through farm residue	1920	7970	5.98
T7 50% N through fertilizer + 50% N through FYM	2088	8957	6.51
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	1966	8404	6.13
T9 Farmers method (10-15 kg N^{-1})	1313	5592	4.09
SEm ±	94	307	--
CD at 5%	273	890	--
CV (%)	11.18	14.84	--
Actual Rainfall (mm) during the season	**389.0**	--	--
Rainfall (mm) during crop growth period	**320.6**	--	--

The data on seed yield of pearl millet presented in table 15 and fig 15 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 2088 kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 6.51 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively.

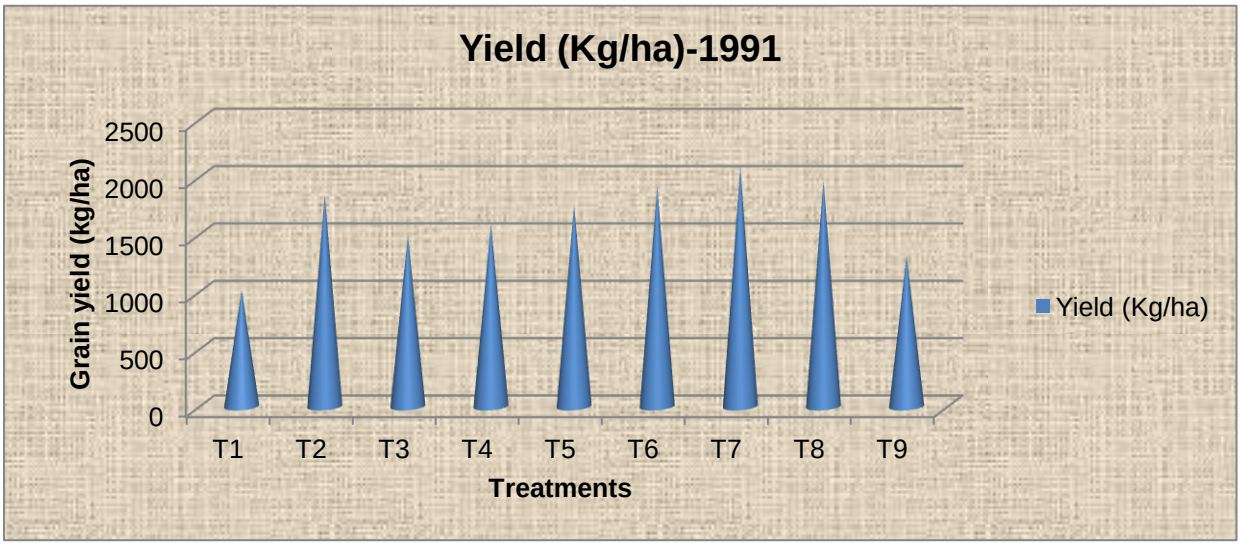

Fig15: Pearl millet grain yield in different treatments

Table 16:Monthly meteorological observations recorded at R.B.S. College , Bichpuri, Agra

Months	Temperature (0^C)		Relative humidity(%)	Rain fall (mm)	Evaporation (mm/day)	Water table (m)
	Max.	Min.				
January	21.5	5.0	93.8	-	2.2	7.3
February	25.8	10.3	89.5	29.2	3.3	7.4
March	31.6	14.5	82.0	3.8	5.2	7.5
April	36.6	17.9	60.5	5.4	9.6	7.5
May	42.1	25.5	50.0	17.2	11.6	7.6
June	40.6	26.5	60.7	-	14.1	7.6
July	37.0	27.6	73.4	107.4	7.6	7.7
August	32.2	25.8	90.2	166.2	3.8	7.5
September	34.5	23.7	84.2	124.2	4.2	7.3
October	34.6	15.6	81.4	-	4.7	7.3
November	27.1	10.4	86.7	7.0	2.6	7.3
December	22.2	7.5	97.0	13.0	1.5	7.3

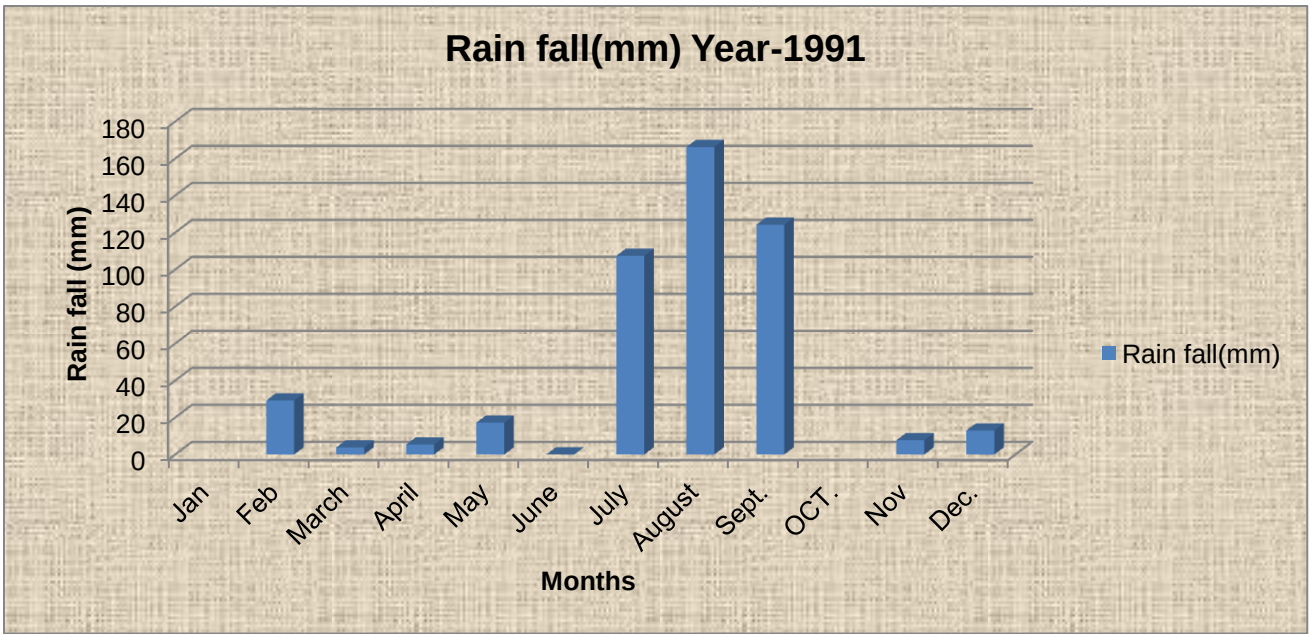

Fig 16: Monthly rain fall distribution

Temperature minimum and maximum: In the year 1991 the maximum temperature varied from 21.5 to 42.1 ^{o}c and minimum was ranged from 5.0 to 27.6 ^{o}c .

Relative humidity (%): The relative humidity in the year 1991 varied from 50.0 to 97.0%.

Rain fall (mm): The total precipitation in the year 1991 was recorded 389.0 mm and in the crop growth period it was recorded 320.6 mm.

Evaporation: The evaporation in the year 1991 ranged from 1.5 to 14.1 mm/day.

Water table: The water table position during the period from January 1991 to December 1991 is presented in table 16. It was variable in different months and varied from 7.3 to 7.7 m.

Table 17: Effect of different treatments on pearl millet crop

Treatment	Year 1992		
	Grain Yield (kg/ha)	Stover Yield (kg/ha)	RW U E (kg/ha-mm)
T1 Control	1025	5232	1.85
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	2299	7196	4.16
T3 Half of he recommended dose of fertilizer	1526	6555	2.76
T4 50% N of the recommended dose to meet through farm residue	1453	6096	2.63
T5 50% N of the recommended dose to meet through FYM	1725	6244	3.12
T6 50% N through fertilizer + 50% N through farm residue	2077	7070	3.75
T7 50% N through fertilizer + 50% N through FYM	2340	7935	4.23
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	2326	7872	4.21
T9 Farmers method (10-15 kg N^{-1})	1326	5594	2.40
SEm ±	88	302	--
CD at 5%	294	880	--
CV (%)	9.89	9.09	--
Actual Rainfall (mm) during the season	**569.2**	--	--
Rainfall (mm) during crop growth period	**552.4**	--	--

The data on seed yield of pearl millet presented in table 17& fig 17 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 2340 kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 4.23 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively.

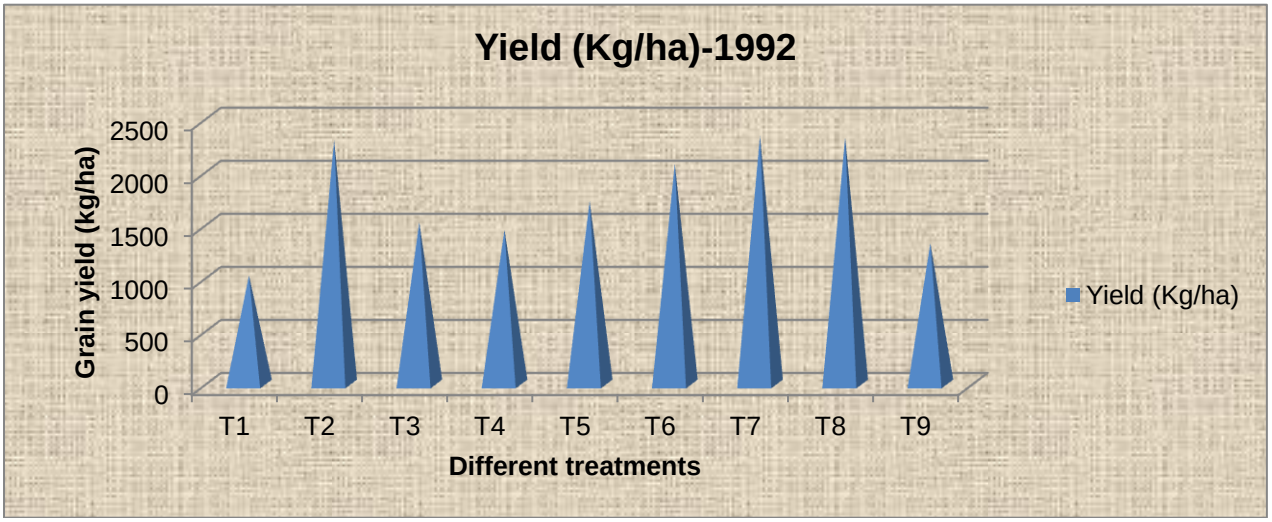

Fig 17: Pearl millet grain yield in different treatments

Table 18: Monthly meteorological observations recorded at R.B.S. College ,Bichpuri, Agra

Months	Temperature(0^C) Max.	Min.	Relative humidity (%)	Rain fall (mm)	Evaporation (mm/day)	Water table (m)
January	22.2	6.9	94.0	4.4	2.1	7.3
February	23.4	19.0	95.7	7.6	2.9	7.3
March	31.4	13.6	83.0	14.4	5.8	7.4
April	36.2	18.6	55.8	-	7.6	7.4
May	40.9	23.0	49.7	12.6	10.2	7.2
June	42.2	27.6	48.5	49.6	11.9	7.7
July	41.8	26.4	73.2	135.2	4.2	7.7
August	40.9	25.8	87.2	291.2	4.8	7.1
September	35.6	23.5	89.4	135.4	4.2	7.2
October	32.3	18.3	90.0	125.8	3.9	6.9
November	27.1	9.1	65.4	7.4	2.9	6.8
December	24.0	5.5	66.3	-	2.1	6.7

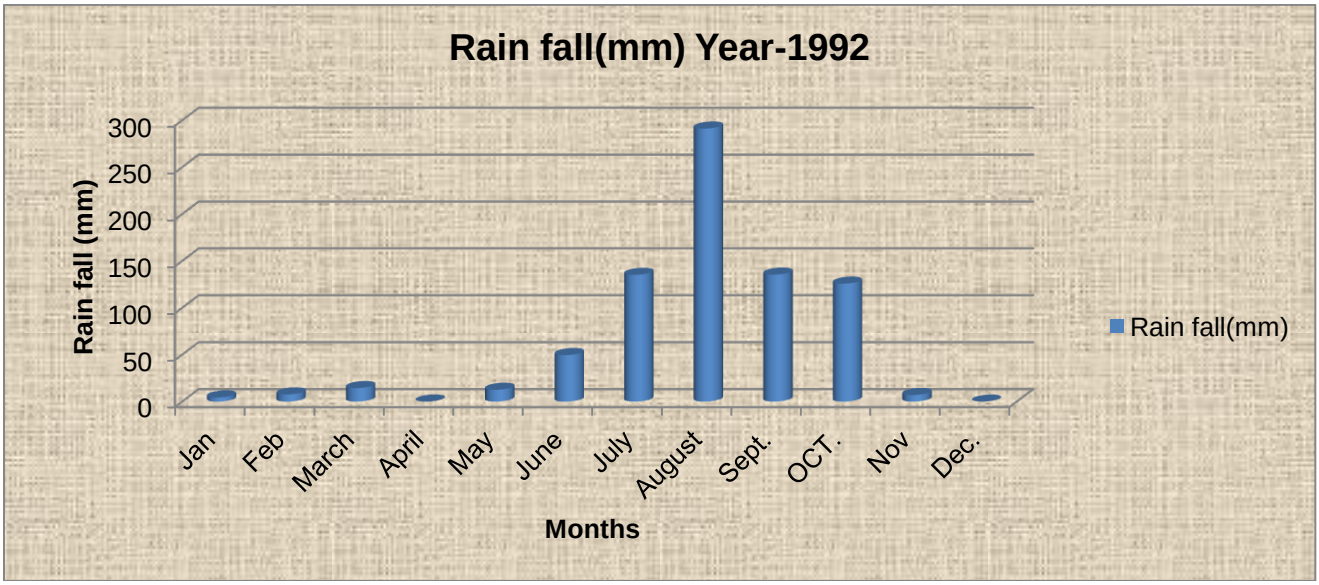

Fig 18: Monthly rain fall distribution

Temperature minimum and maximum: In the year 1992 the maximum temperature varied from 22.2 to 42.2 ^{o} c and minimum was ranged from 5.5 to 27.6 ^{o}c .

Relative humidity (%): The relative humidity in the year 1992 varied from 48.5 to 95.7%.

Rain fall (mm): The total precipitation in the year 1992 was recorded 569.2 mm and in the crop growth period it was recorded 552.4 mm.

Evaporation: The evaporation in the year 1992 ranged from 2.1 to 11.9 mm/day.

Water table: The water table position during the period from January 1992 to December 1992 is presented in table 18. It was variable in different months and varied from 6.7 to 7.7 m

Table 19: Effect of different treatments on pearl millet crop

Treatment	Year 1993		
	Grain Yield (kg/ha)	Stover Yield (kg/ha)	RW U E (kg/ha-mm))
T1 Control	1516	3700	4.51
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	3125	5375	9.30
T3 Half of he recommended dose of fertilizer	2410	4629	7.17
T4 50% N of the recommended dose to meet through farm residue	2315	4139	6.88
T5 50% N of the recommended dose to meet through FYM	2626	4872	7.81
T6 50% N through fertilizer + 50% N through farm residue	2910	5012	8.66
T7 50% N through fertilizer + 50% N through FYM	3370	5592	10.02
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	3250	5400	9.67
T9 Farmers method (10-15 kg N^{-1})	2012	4015	5.98
SEm ±	130	303	--
CD at 5%	380	731	--
CV (%)	10.00	10.50	--
Actual Rainfall (mm) during the season	**525.0**	--	--
Rainfall (mm) during crop growth period	**336.0**	--	--

The data on seed yield of pearl millet presented in table 19 & fig 19 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 12003370 kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 10.02 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively**.**

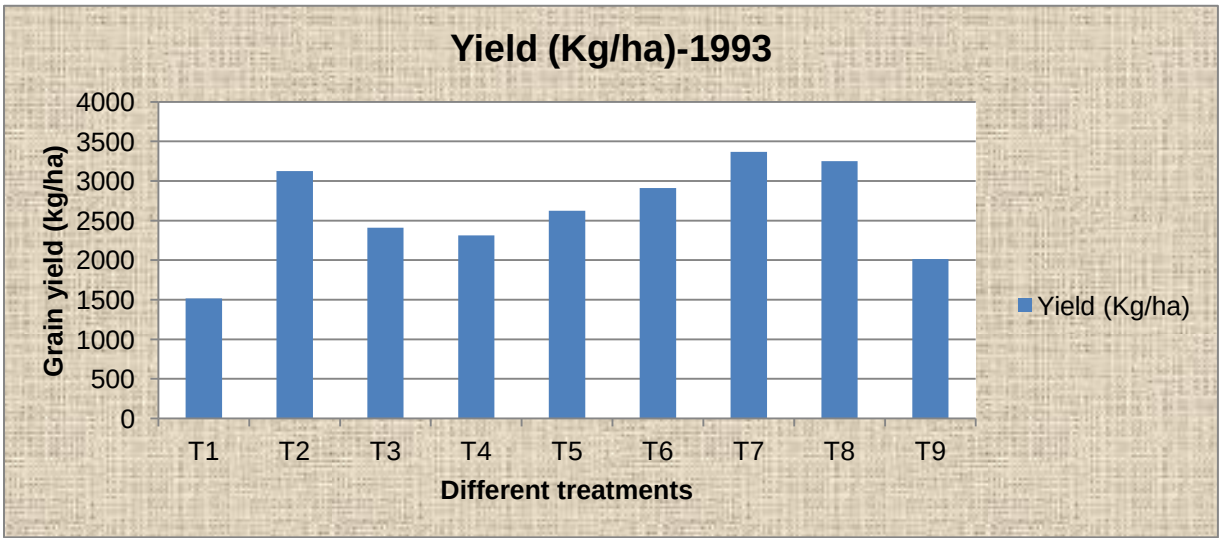

Fig 19: Pearl millet grain yield in different treatments

Table 20: Monthly meteorological observations recorded at R.B.S. College, Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity(%)	Rain fall (mm)	Evaporation (mm/day)	Water table (m)
January	21.4	4.4	60.7	-	2.3	6.8
February	26.8	7.2	55.0	21.6	3.6	6.9
March	29.1	10.5	42.6	13.4	5.7	7.0
April	38.3	16.2	40.8	1.6	9.9	7.1
May	29.4	19.1	48.0	-	12.2	7.2
June	38.4	22.3	60.0	36.2	12.5	4.2
July	32.6	20.8	83.2	189.2	5.6	6.8
August	34.0	23.2	78.3	101.2	7.1	5.8
September	30.4	22.2	93.3	294.4	4.7	5.4
October	34.3	16.1	82.4	-	4.1	5.4
November	30.4	11.3	91.0	-	3.2	5.9
December	23.9	5.5	93.7	-	3.2	6.2

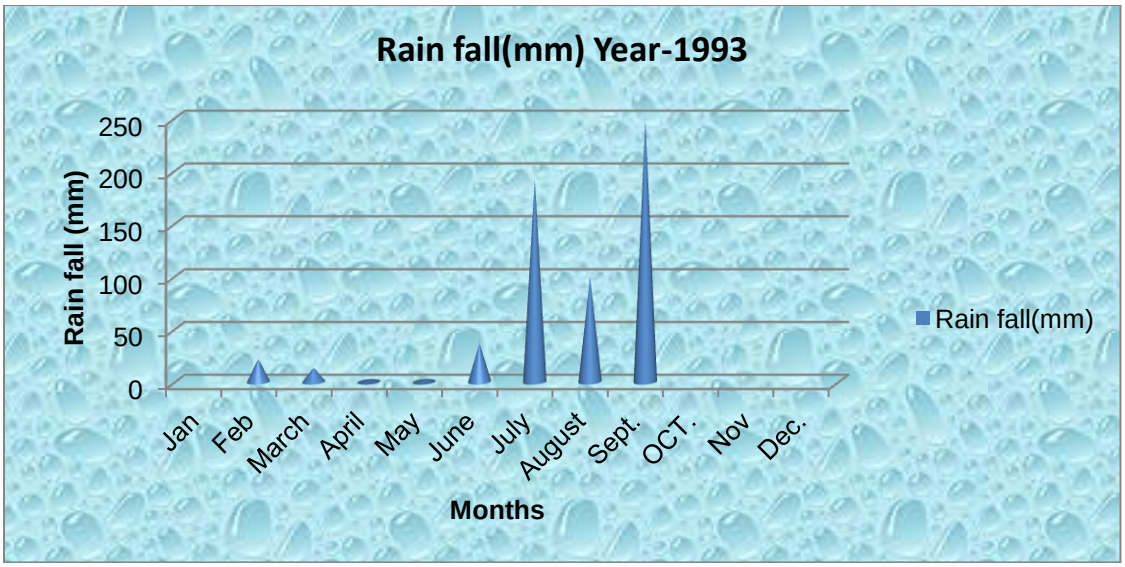

Fig 20: Monthly rain fall distribution

Weather and crop condition:

Temperature minimum and maximum: In the year 1993 the maximum temperature varied from 21.4 to 38.4 ^{o}c and minimum was ranged from 4.4 to 23.2 ^{o}c .

Relative humidity (%): The relative humidity in the year 1993 varied from 40.8 to 93.7 %.

Rain fall (mm): The total precipitation in the year 1993 was recorded 525.0 mm and in the crop growth period it was recorded 336.0 mm.

Evaporation: The evaporation in the year 1993 ranged from 2.3 to 12.5 mm/day.

Water table: The water table position during the period from January 1993 to December 1993 is presented in table 20. It was variable in different months and varied from 4.2 to 7.2 m.

Table 21: Effect of different treatments on pearl millet crop

Treatment	Year 1994		
	Grain Yield (kg/ha)	Stover Yield (kg/ha)	RW U E (kg/ha-mm)
T1 Control	750	2173	2.21
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	1660	4150	4.90
T3 Half of he recommended dose of fertilizer	1289	3545	3.80
T4 50% N of the recommended dose to meet through farm residue	1320	3564	3.90
T5 50% N of the recommended dose to meet through FYM	1435	3703	4.24
T6 50% N through fertilizer + 50% N through farm residue	1625	4144	4.80
T7 50% N through fertilizer + 50% N through FYM	1775	4437	5.24
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	1715	4322	5.06
T9 Farmers method (10-15 kg N^{-1})	860	2494	2.54
SEm ±	77	196	--
CD at 5%	223	571	--
CV (%)	11.10	10.85	--
Actual Rainfall (mm) during the season	**568.5**	--	--
Rainfall (mm) during crop growth period	**338.4**	--	--

The data on seed yield of pearl millet presented in table 21 and fig 21 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 1775kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 5.24 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively**.**

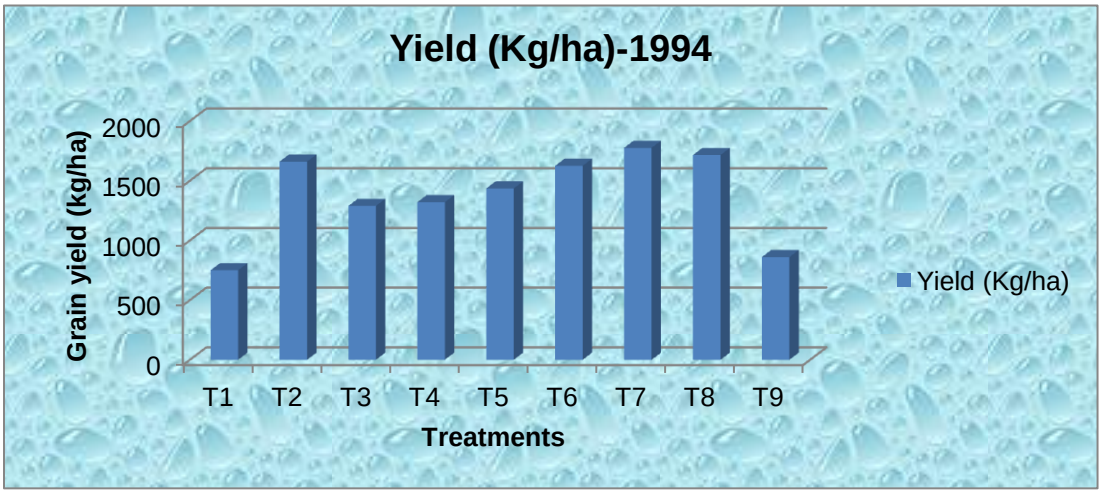

Fig 21: Pearl millet yield in different treatment

Table 22: Monthly meteorological observations recorded at R.B.S. College ,Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity (%)	Rain fall (mm)	Evaporation (mm/day)	Water table (m)
January	21.8	7.7	74.2	18.8	2.1	6.4
February	24.8	8.2	62.8	52.4	3.0	6.5
March	32.5	13.8	51.5	48.2	4.7	6.7
April	35.2	20.2	42.8	-	10.1	6.4
May	43.6	24.2	32.0	0.6	12.1	6.9
June	42.9	27.1	46.1	22.8	13.1	7.0
July	34.1	24.6	83.6	342.6	4.4	5.7
August	33.7	24.7	84.3	212.0	4.9	3.0
September	35.5	22.5	69.4	23.2	5.1	2.9
October	35.1	15.6	57.0	-	4.2	3.4
November	30.6	10.5	58.6	-	3.2	4.5
December	36.2	7.8	62.2	-	2.8	5.3

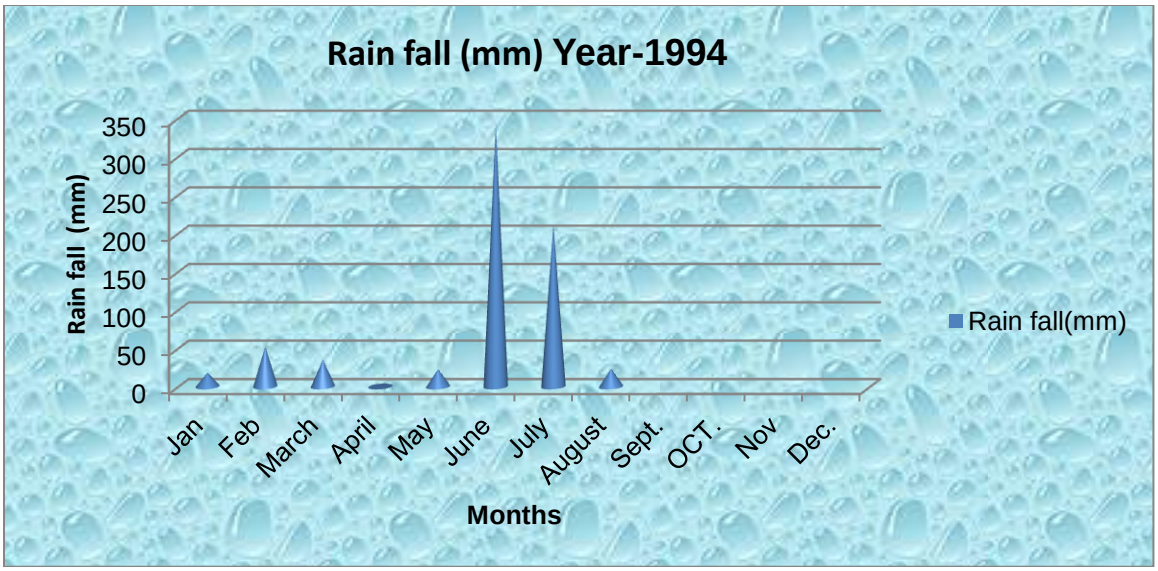

Fig 21: Monthly rain fall distribution

Temperature minimum and maximum: In the year 1994 the maximum temperature varied from 21.8 to 43.6 ^{o}c and minimum was ranged from 7.7 to 27.1 ^{o}c .

Relative humidity (%): The relative humidity in the year 1994 varied from 32.0 to 84.3%.

Rain fall (mm): The total precipitation in the year 1994 was recorded 568.5 mm and in the crop growth period it was recorded 338.4 mm.

Evaporation: The evaporation in the year 1994 ranged from 2.1 to 13.1 mm/day.

Water table: The water table position during the period from January 1994 to December 1994 is presented in table 21. It was variable in different months and varied from 2.9 to 7.0 m.

Table 23 : Effect of different treatments on pearl millet crop

Treatment	Year 1995		
	Grain Yield (kg/ha)	Stover Yield (kg/ha)	RW U E (kg/ha-mm)
T1 Control	1342	3985	2.53
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	2648	5912	5.00
T3 Half of he recommended dose of fertilizer	1980	4768	3.73
T4 50% N of the recommended dose to meet through farm residuue	1822	4507	3.44
T5 50% N of the recommended dose to meet through FYM	1987	4916	3.75
T6 50% N through fertilizer + 50% N through farm residue	2357	5538	4.45
T7 50% N through fertilizer + 50% N through FYM	2708	5578	5.11
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	2662	5751	5.02
T9 Farmers method (10-15 kg N^{-1})	1653	4515	3.12
SEm ±	114	262	--
CD at 5%	331	763	--
CV (%)	10.68	10.35	--
Actual Rainfall (mm) during the season	**631.8**	--	--
Rainfall (mm) during crop growth period	**529.6**	--	--

The data on seed yield of pearl millet presented in table 23and fig 23 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 2708 kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 5.11 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively**.**

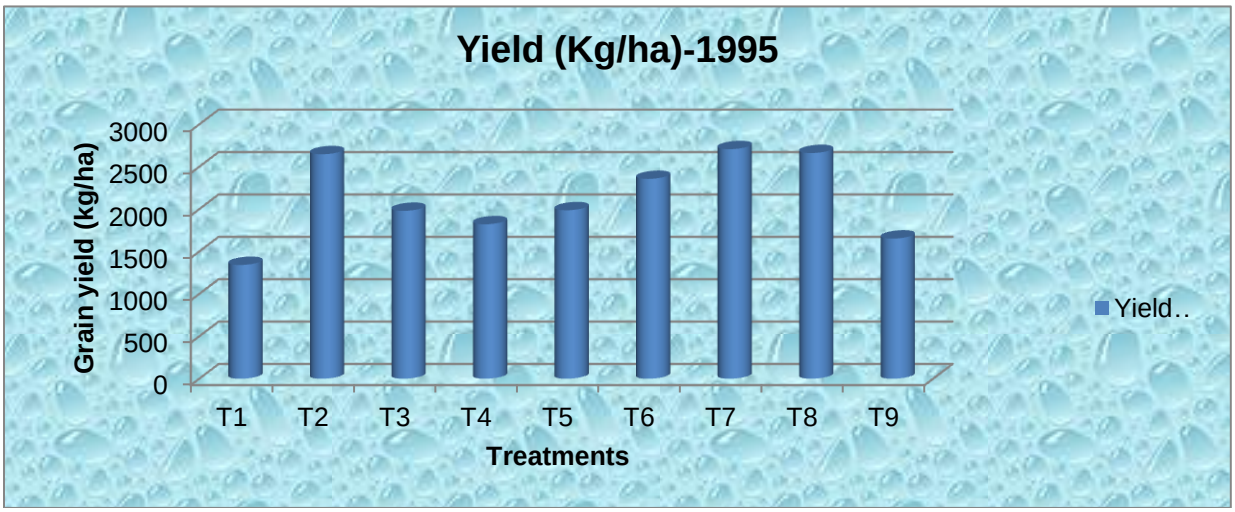

Fig 23: Pearl millet grain yield in different treatments

Table 24: Monthly meteorological observations recorded at R.B.S. College ,Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity (%)	Rain fall (mm)	Evaporation (mm/day)	Water table (m)
January	21.8	5.2	69.2	26.0	2.4	5.5
February	26.8	7.9	60.7	2.0	3.2	5.6
March	30.7	11.9	446	8.6	4.1	5.8
April	38.6	18.8	41.4	-	8.1	6.4
May	42.2	26.4	32.0	-	11.4	7.1
June	48.1	28.3	38.1	42.8	12.2	7.7
July	37.0	31.0	69.7	139.6	9.2	7.1
August	30.6	28.4	84.1	370.6	3.7	6.9
September	34.1	27.0	71.2	77.8	4.1	6.3
October	36.6	21.8	54.0	-	4.4	6.0
November	28.5	13.2	57.3	-	3.5	6.1
December	23.6	7.5	64.1	-	2.5	6.1

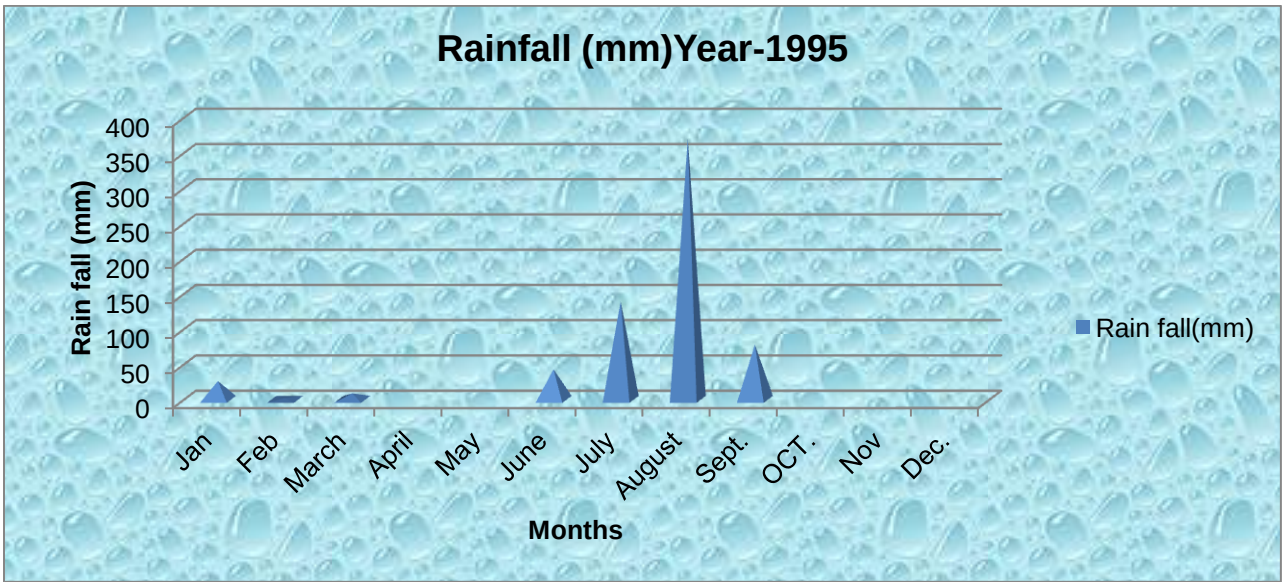

Fig 24: Monthly rainfall distribution

Temperature minimum and maximum: In the year 1995 the maximum temperature varied from 21.8 to 48.1 ^{o}c and minimum was ranged from 5.2 to 31.0 ^{o}c .

Relative humidity (%): The relative humidity in the year 1995 varied from 32.0 to 84.1 %.

Rain fall (mm): The total precipitation in the year 1995 was recorded 631.8 mm and in the crop growth period it was recorded 529.6 mm.

Evaporation: The evaporation in the year 1995 ranged from 2.4 to 12.2 mm/day.

Water table: The water table position during the period from January 1995 to December 1995 is presented in table 24. It was variable in different months and varied from 5.5 to 7.7 m.

Table 25 : Effect of different treatments on pearl millet crop

Treatment	Year 1996		
	Grain Yield (kg/ha)	**Stover Yield (kg/ha)**	**RW U E (kg/ha-mm)**
T1 Control	1150	3680	2.11
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	2046	5833	3.75
T3 Half of he recommended dose of fertilizer	1565	4873	2.87
T4 50% N of the recommended dose to meet through farm residue	1498	4543	2.74
T5 50% N of the recommended dose to meet through FYM	1570	4967	2.88
T6 50% N through fertilizer + 50% N through farm residue	1890	5392	3.46
T7 50% N through fertilizer + 50% N through FYM	2125	6062	3.89
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	2105	5900	3.86
T9 Farmers method (10-15 kg N^{-1})	1314	4070	2.41
SEm ±	86	263	--
CD at 5%	250	765	--
CV (%)	10.12	10.43	--
Actual Rainfall (mm) during the season	**551.2**	--	--
Rainfall (mm) during crop growth period	**545.0**	--	--

The data on seed yield of pearl millet presented in table 25 and fig25 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 2125 kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 3.89 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively**.**

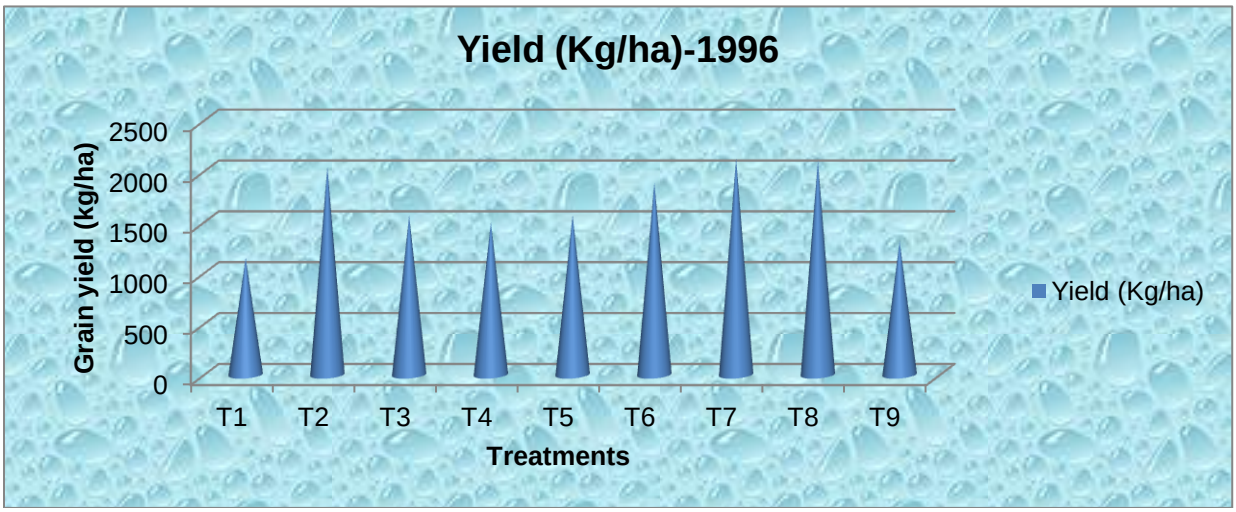

Fig 25: Pearl millet grain yield in different treatments

Table 26: Monthly meteorological observations recorded at R.B.S. College , Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity (%)	Rain fall (mm)	Evaporation (mm/day)	Water table (m)
January	20.9	5.2	67.5	1.4	2.0	6.1
February	22.8	6.6	60.3	20.4	2.7	6.1
March	29.0	11.9	45.3	3.6	5.0	5.9
April	37.9	17.4	27.9	2.8	8.4	6.3
May	42.3	26.4	33.7	32.8	9.6	7.0
June	42.3	26.4	55.3	42.8	8.7	7.6
July	32.5	29.6	77.2	141.6	5.6	7.5
August	30.7	24.9	85.7	2504	2.9	7.5
September	31.2	20.1	86.0	9.6	3.7	3.0
October	30.1	19.2	85.2	-	3.6	3.1
November	28.2	14.9	90.0	-	3.5	3.2
December	22.9	4.9	93.0	-	2.3	3.0

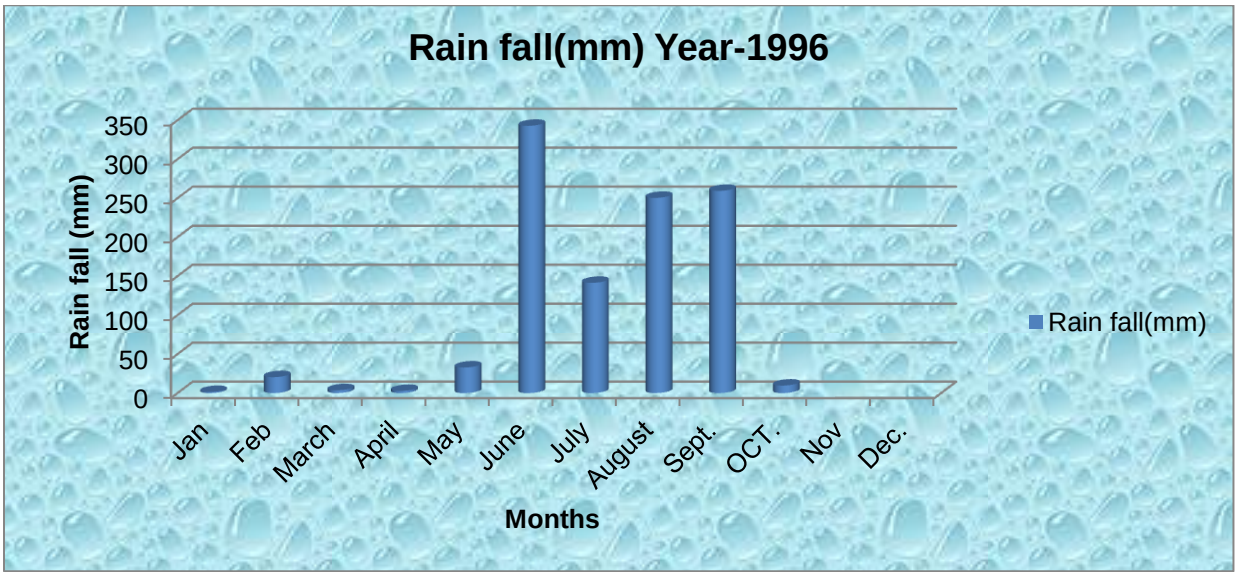

Fig 26: Monthly rain fall distribution

Temperature minimum and maximum: In the year 1996 the maximum temperature varied from 20.9 to 42.3 ^{o}c and minimum was ranged from 4.9 to 29.6 ^{o}c .

Relative humidity (%): The relative humidity in the year 1996 varied from 33.7 to 93.0%.

Rain fall (mm): The total precipitation in the year 1996 was recorded 551.2 mm and in the crop growth period it was recorded 545.0 mm.

Evaporation: The evaporation in the year 1996 ranged from 2.0 to 9.6 mm/day.

Water table: The water table position during the period from January 1996 to December 1996 is presented in table 26. It was variable in different months and varied from 3.0 to 7.6 m.

Table 27 : Effect of different treatments on pearl millet crop

Treatment	Year 1997		
	Grain Yield (kg/ha)	Stover Yield (kg/ha)	RW U E (kg/ha-mm)
T1 Control	1250	3880	2.76
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	2453	6160	5.41
T3 Half of he recommended dose of fertilizer	1925	5050	4.25
T4 50% N of the recommended dose to meet through farm residuuue	1909	4840	4.21
T5 50% N of the recommended dose to meet through FYM	1977	5175	4.36
T6 50% N through fertilizer + 50% N through farm residue	2357	5612	5.20
T7 50% N through fertilizer + 50% N through FYM	2550	6465	5.63
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	2510	6270	5.54
T9 Farmers method (10-15 kg N^{-1})	1389	4155	3.06
SEm ±	126	256	--
CD at 5%	367	972	--
CV (%)	--	--	--
Actual Rainfall (mm) during the season	**512.6**	--	--
Rainfall (mm) during crop growth period	**452.6**	--	--

The data on seed yield of pearl millet presented in table 27 and fig 27 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 2550 kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 5.63 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively**.**

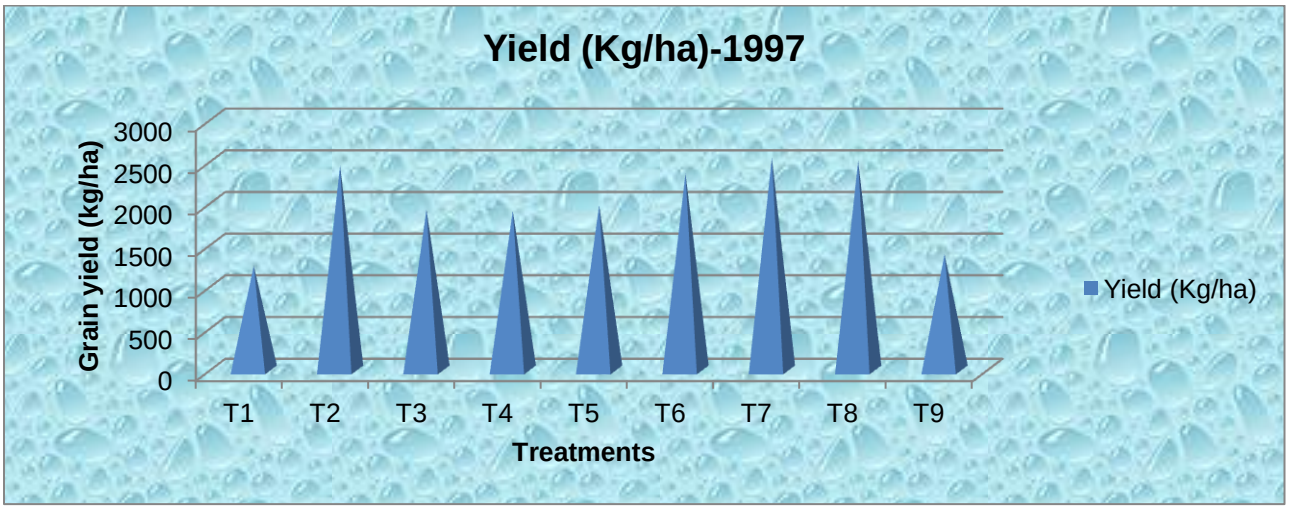

Fig 27: Pearl millet grain yield in different treatments

Table 28: Monthly meteorological observations recorded at R.B.S. College, Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity (%)	Rain fall (mm)	Evaporation (mm/day)	Water table (m)
January	20.8	4.2	93.0	4.6	1.9	3.3
February	22.1	5.9	89.0	4.8	3.4	3.3
March	27.5	12.4	87.0	-	3.9	3.4
April	31.9	17.8	74.0	4.4	4.4	3.6
May	37.3	21.9	65.0	25.6	9.8	3.8
June	37.8	24.2	74.0	21.0	8.2	4.4
July	35.8	26.5	83.0	133.4	5.1	4.3
August	33.1	24.7	86.0	206.2	4.0	4.5
September	32.5	23.9	91.0	172.8	3.6	4.3
October	28.4	18.1	92.0	33.6	3.1	4.4
November	24.6	14.5	96.0	42.6	2.1	4.7
December	17.6	10.6	91.0	51.6	1.3	4.3

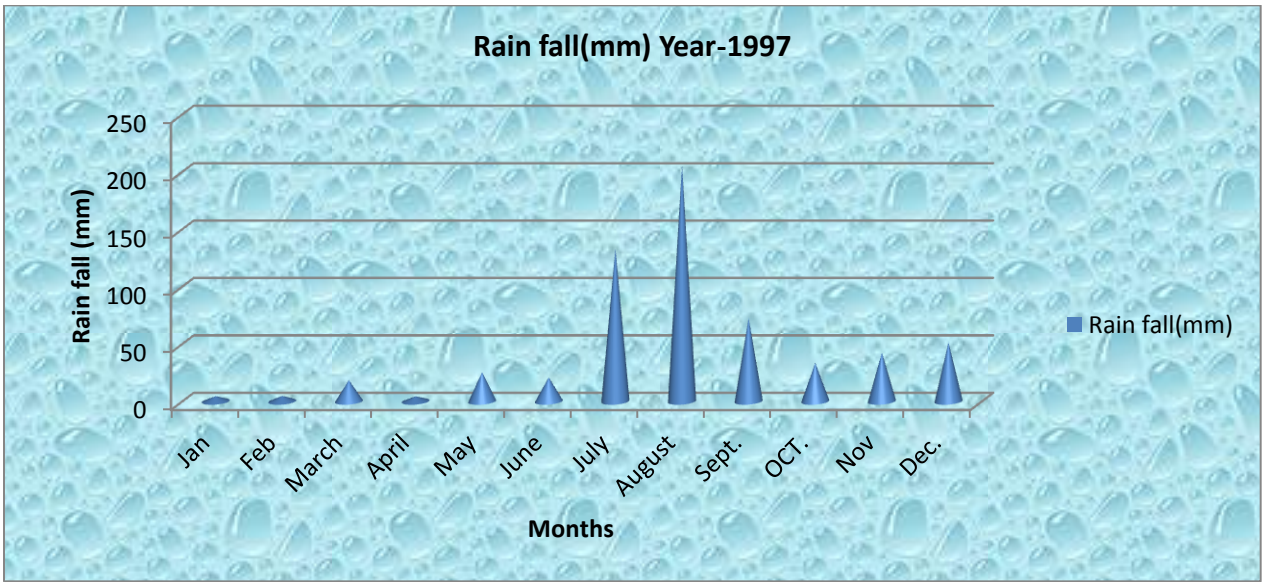

Fig 28: Monthly rain fall distribution

Temperature minimum and maximum: In the year 1997 the maximum temperature varied from 17.6 to 37.8 ^{o}c and minimum was ranged from 4.2 to 26.5 ^{o}c .

Relative humidity (%): The relative humidity in the year 1997 varied from 65.0 to 96.0%.

Rain fall (mm): The total precipitation in the year 1997 was recorded 512.6 mm and in the crop growth period it was recorded 452.6 mm.

Evaporation: The evaporation in the year 1997 ranged from 1.3 to 9.8 mm/day.

Water table: The water table position during the period from January 1997 to December 1997 is presented in table 28. It was variable in different months and varied from 3.3 to 4.7 m.

Table 29: Effect of different treatments on pearl millet crop

Treatment	Year 1998		
	Grain Yield (kg/ha)	Stover Yield (kg/ha)	RW U E (kg/ha-mm)
T1 Control	1280	4053	2.24
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	2610	5642	4.57
T3 Half of he recommended dose of fertilizer	2015	4740	3.53
T4 50% N of the recommended dose to meet through farm residue	1896	4715	3.32
T5 50% N of the recommended dose to meet through FYM	2065	4900	3.62
T6 50% N through fertilizer + 50% N through farm residue	2460	3400	4.31
T7 50% N through fertilizer + 50% N through FYM	2728	5893	4.78
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	2698	5800	4.73
T9 Farmers method (10-15 kg N^{-1})	1520	4200	2.66
SEm ±	112	264	--
CD at 5%	326	770	--
CV (%)	10.35	10.49	--
Actual Rainfall (mm) during the season	**594.0**	--	--
Rainfall (mm) during crop growth period	**570.3**	--	--

The data on seed yield of pearl millet presented in table 29 and fig 29 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 2728 kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 4.78 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively**.**

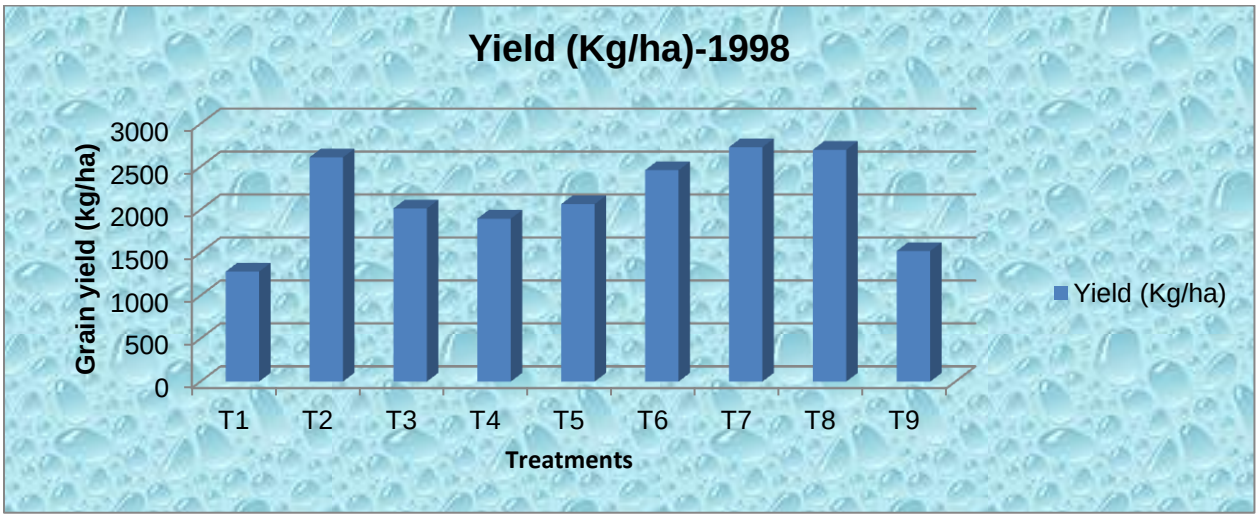

Fig 29: Pearl millet grain yield in different

Table 30: Monthly meteorological observations recorded at R.B.S. College ,Bichpuri,Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	19.4	5.5	90.0	-	1.9	5.1
February	23.4	10.2	89.0	3.4	2.6	5.1
March	26.4	13.5	88.0	18.6	4.2	5.2
April	35.8	19.7	72.0	18.2	7.2	3.4
May	40.3	25.1	64.0	3.4	10.1	3.5
June	38.3	30.7	75.0	15.6	9.3	3.9
July	32.5	28.6	82.0	246.8	4.5	4.2
August	31.7	27.8	87.0	282.2	3.1	4.2
September	33.4	28.4	91.0	103.3	4.0	4.3
October	31.8	24.4	93.0	32.4	3.4	4.6
November	28.6	18.4	97.0	-	2.6	4.5
December	17.6	11.3	96.0	-	1.8	4.7

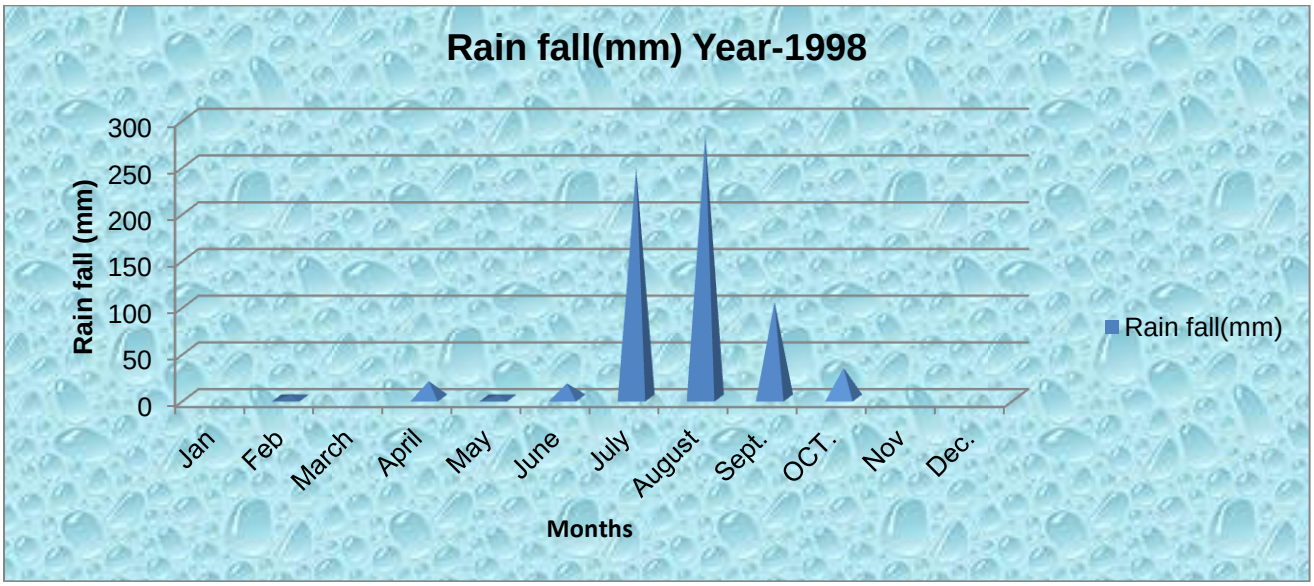

Fig 30: Monthly rain fall distribution

Temperature minimum and maximum: In the year 1998 the maximum temperature varied from 17.6 to 40.3 ^{o}c and minimum was ranged from 5.5 to 30.7 ^{o}c .

Relative humidity (%): The relative humidity in the year 1998 varied from 64.0 to 97.0%.

Rain fall (mm): The total precipitation in the year 1998 was recorded 594.0 mm and in the crop growth period it was recorded 570.3 mm.

Evaporation: The evaporation in the year 1998 ranged from 1.8 to 10.1 mm/day.

Water table: The water table position during the period from January 1998 to December 1998 is presented in table 30. It was variable in different months and varied from 3.4 to 5.2 m.

Table 31 : Effect of different treatments on pearl millet crop

Treatment	Year 1999		
	Grain Yield (kg/ha)	**Stover Yield (kg/ha)**	**RW U E (kg/ha-mm)**
T1 Control	743	1817	2.22
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	1309	2987	3.92
T3 Half of he recommended dose of fertilizer	963	2563	2.88
T4 50% N of the recommended dose to meet through farm residue	1093	2340	3.27
T5 50% N of the recommended dose to meet through FYM	1109	2625	3.32
T6 50% N through fertilizer + 50% N through farm residue	1284	2880	3.85
T7 50% N through fertilizer + 50% N through FYM	1412	3180	4.23
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	1363	3030	4.08
T9 Farmers method (10-15 kg N^{-1})	842	1968	2.52
SEm ±	79	187	--
CD at 5%	230	545	--
CV (%)	14.06	14.40	--
Actual Rainfall (mm) during the season	**715.6**	--	--
Rainfall (mm) during crop growth period	**333.4**	--	--

The data on seed yield of pearl millet presented in table 31and fig31clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 1412 kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 4.23 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively**.**

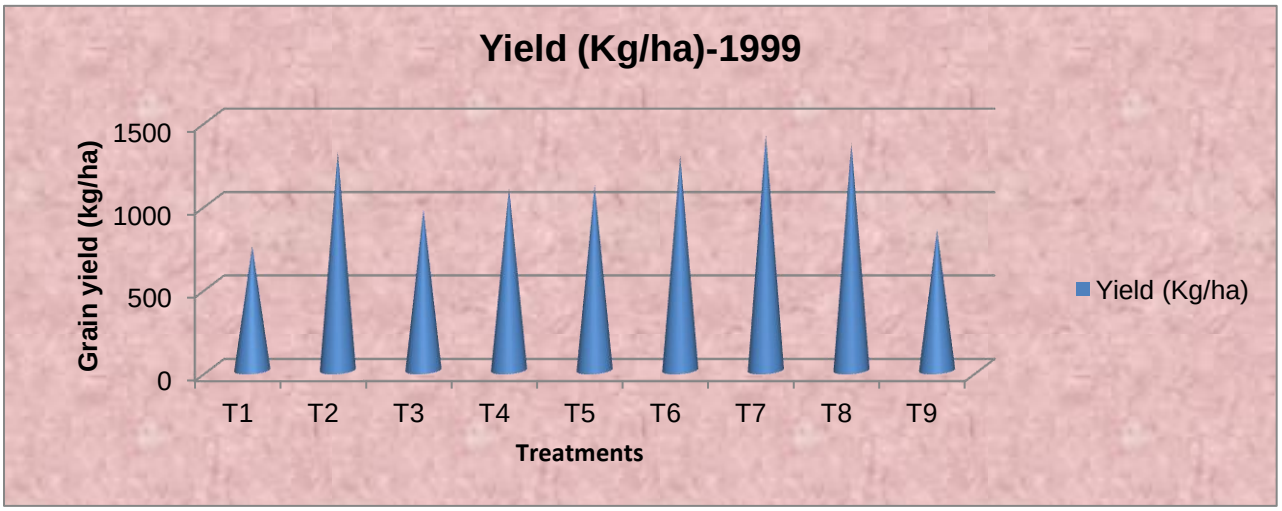

Fig 31: Pearl millet grain yield in different

Table 32: Monthly meteorological observations recorded at R.B.S. College ,Bichpuri,Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	17.8	8.4	84.0	12.6	1.1	4.7
February	22.9	12.1	72.0	15.4	2.4	3.8
March	30.0	18.1	66.0	-	5.5	3.9
April	39.4	26.6	67.0	-	6.4	4.1
May	40.3	29.4	62.0	-	1.8	4.5
June	32.7	30.4	56.0	115.8	2.3	4.8
July	32.5	28.6	82.0	136.2	2.5	4.2
August	31.7	27.8	87.0	290.6	2.9	4.2
September	33.4	28.4	91.0	288.8	3.1	4.2
October	31.8	24.4	93.0	4.4	3.5	4.6
November	28.6	18.4	97.0	-	2.8	4.7
December	17.6	11.3	96.0	-	3.2	4.7

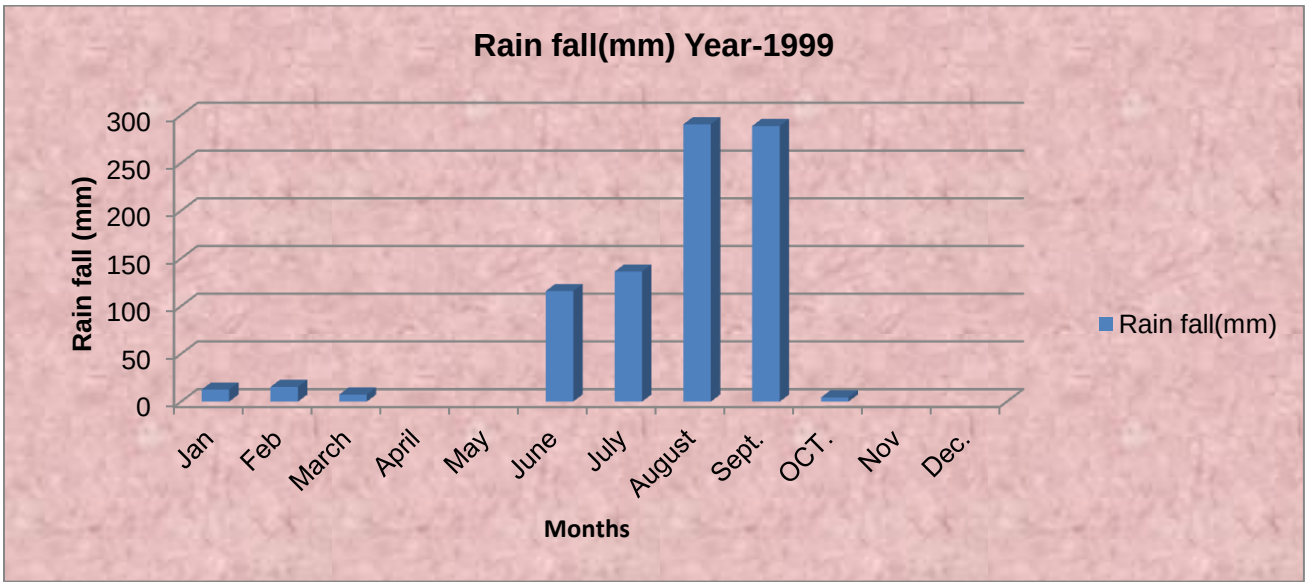

Fig 32: Monthly rainfall distribution

Temperature minimum and maximum: In the year 1999 the maximum temperature varied from 17.8 to 40.3 ^{o}c and minimum was ranged from 8.4 to 30.4 ^{o}c .

Relative humidity (%): The relative humidity in the year 1999 varied from 56.0 to 97.0%.

Rain fall (mm): The total precipitation in the year 1999 was recorded 715.6 mm and in the crop growth period it was recorded 333.4 mm.

Evaporation: The evaporation in the year 1999 ranged from 1.1 to 6.4 mm/day.

Water table: The water table position during the period from January 1999 to December 1999 is presented in table32. It was variable in different months and varied from 3.8 to 4.8 m.

Table 33 : Effect of different treatments on pearl millet crop

Treatment	Year 2000		
	Grain Yield (kg/ha)	Stover Yield (kg/ha)	RW U E (kg/ha-mm)
T1 Control	1295	3825	4.52
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	2348	5705	8.20
T3 Half of he recommended dose of fertilizer	1724	4655	6.02
T4 50% N of the recommended dose to meet through farm residue	1785	4447	6.24
T5 50% N of the recommended dose to meet through FYM	1845	4745	6.45
T6 50% N through fertilizer + 50% N through farm residue	2156	5547	7.53
T7 50% N through fertilizer + 50% N through FYM	2456	5821	8.58
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	2375	5700	8.30
T9 Farmers method (10-15 kg N^{-1})	1460	3986	5.10
SEm ±	117	310	--
CD at 5%	340	905	--
CV (%)	12.09	12.58	--
Actual Rainfall (mm) during the season	**288.4**	--	--
Rainfall (mm) during crop growth period	**286.0**	--	--

The data on seed yield of pearl millet presented in table 33 and fig. 33 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 2456 kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 8.58 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively.

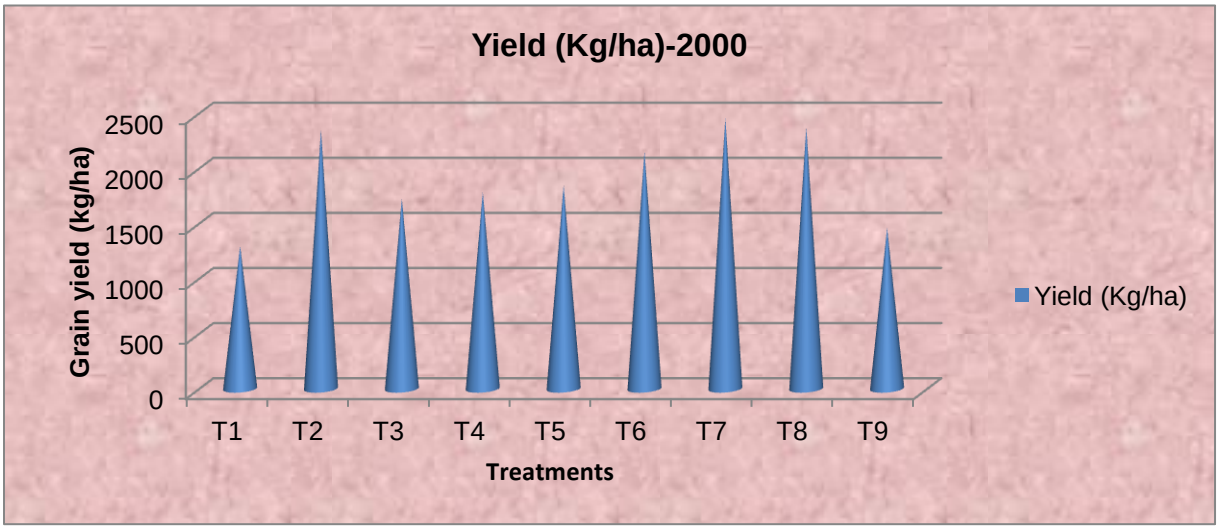

Fig 33: Pearl millet grain yield in different treatments

Table 34:Monthly meteorological observations recorded at R.B.S. College ,Bichpuri,Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	20.1	10.1	86.0	8.4	1.9	3.9
February	21.6	10.8	78.0	1.7	2.3	3.6
March	29.9	17.1	65.0	7.4	4.5	3.5
April	39.1	20.0	69.0	4.8	8.0	3.7
May	40.3	26.9	66.0	8.0	8.0	4.1
June	36.8	27.1	69.0	151.8	4.4	4.3
July	33.6	27.8	79.0	92.8	3.2	4.7
August	32.7	25.5	85.0	141.4	3.6	4.9
September	34.0	23.2	90.0	54.4	2.9	4.9
October	35.7	17.8	95.0	-	3.2	5.4
November	31.1	14.5	97.0	-	2.2	5.6
December	24.6	7.2	97.0	-	1.3	6.0

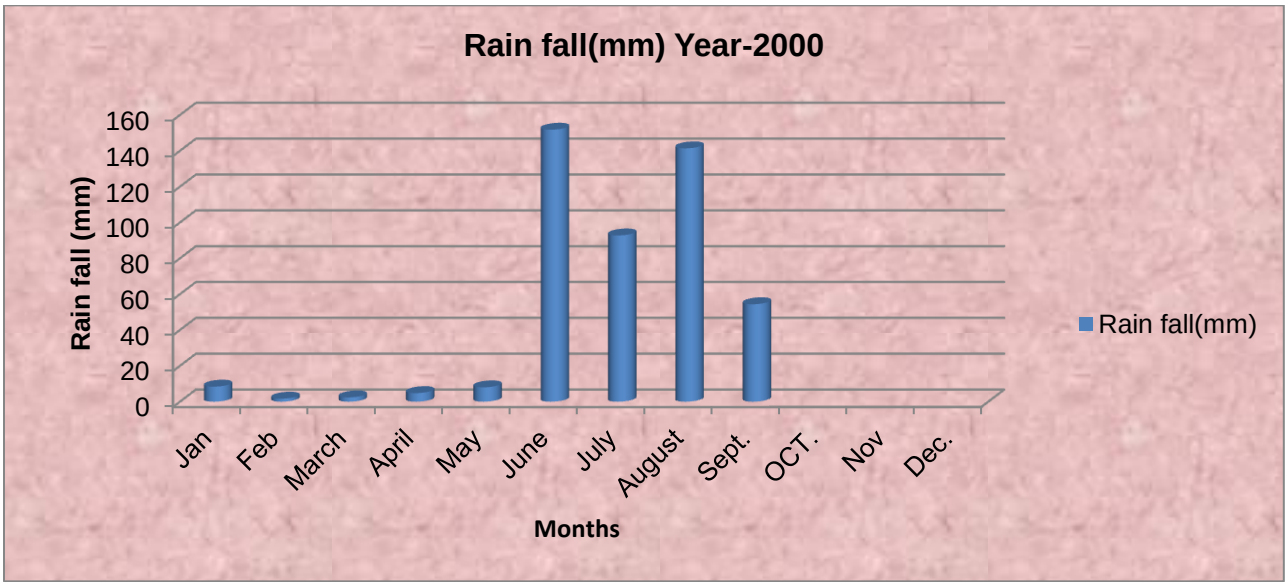

Fig 34: Monthly rain fall distribution

Temperature minimum and maximum: In the year 2000 the maximum temperature varied from 20.1 to 40.3 ^{o}c and minimum was ranged from 7.2 to 27.8 ^{o}c .

Relative humidity (%): The relative humidity in the year 2000 varied from 65.0 to 97.0%.

Rain fall (mm): The total precipitation in the year 2000 was recorded 288.4 mm and in the crop growth period it was recorded 286.0 mm.

Evaporation: The evaporation in the year 2000 ranged from 1.3 to 8.0 mm/day.

Water table: The water table position during the period from January 2000 to December 2000 is presented in table 34. It was variable in different months and varied from 3.5 to 6.0 m.

Table 35 : Effect of different treatments on pearl millet crop

Treatment	Year 2001		
	Grain Yield (kg/ha)	Stover Yield (kg/ha)	W U E (kg/ha-mm)
T1 Control	458	1275	1.09
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	800	2075	1.91
T3 Half of he recommended dose of fertilizer	715	1666	1.71
T4 50% N of the recommended dose to meet through farm residue	845	1722	2.02
T5 50% N of the recommended dose to meet through FYM	760	1742	1.82
T6 50% N through fertilizer + 50% N through farm residue	805	1932	1.92
T7 50% N through fertilizer + 50% N through FYM	890	2175	2.13
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	820	2085	1.96
T9 Farmers method (10-15 kg N^{-1})	585	1480	1.40
SEm ±	42	108	--
CD at 5%	123	325	--
CV (%)	11.54	12.75	--
Actual Rainfall (mm) during the season	**428.3**	--	--
Rainfall (mm) during crop growth period	**418.3**	--	--

The data on seed yield of pearl millet presented in table 35 and fig 35 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 890kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 2.13 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively.

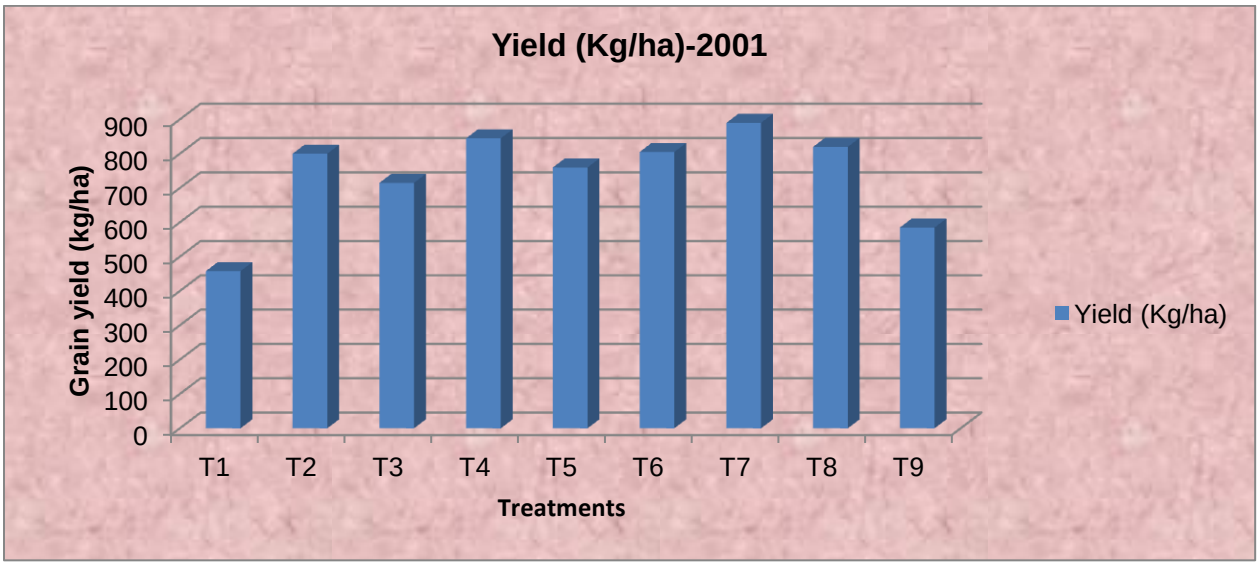

Fig 35 Pearl millet grain yield in different treatments

Table 36: Monthly meteorological observations recorded at R.B.S. College, Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	15.4	7.3	85.0	2.0	1.1	7.1
February	24.7	8.4	79.0	-	2.7	7.2
March	32.2	11.5	68.0	2.4	3.6	7.6
April	36.9	19.7	71.1	23.2	5.6	7.7
May	39.5	25.2	68.0	26.2	5.9	7.9
June	34.4	25.0	70.0	64.0	3.8	8.2
July	31.9	26.2	75.0	188.0	3.3	8.0
August	33.5	26.6	81.0	59.5	3.2	8.1
September	36.6	29.0	89.0	169.2	2.5	8.3
October	33.5	19.9	93.0	2.0	2.3	8.5
November	27.8	9.7	96.0	-	1.4	8.5
December	22.9	8.5	96.0	-	1.2	8.6

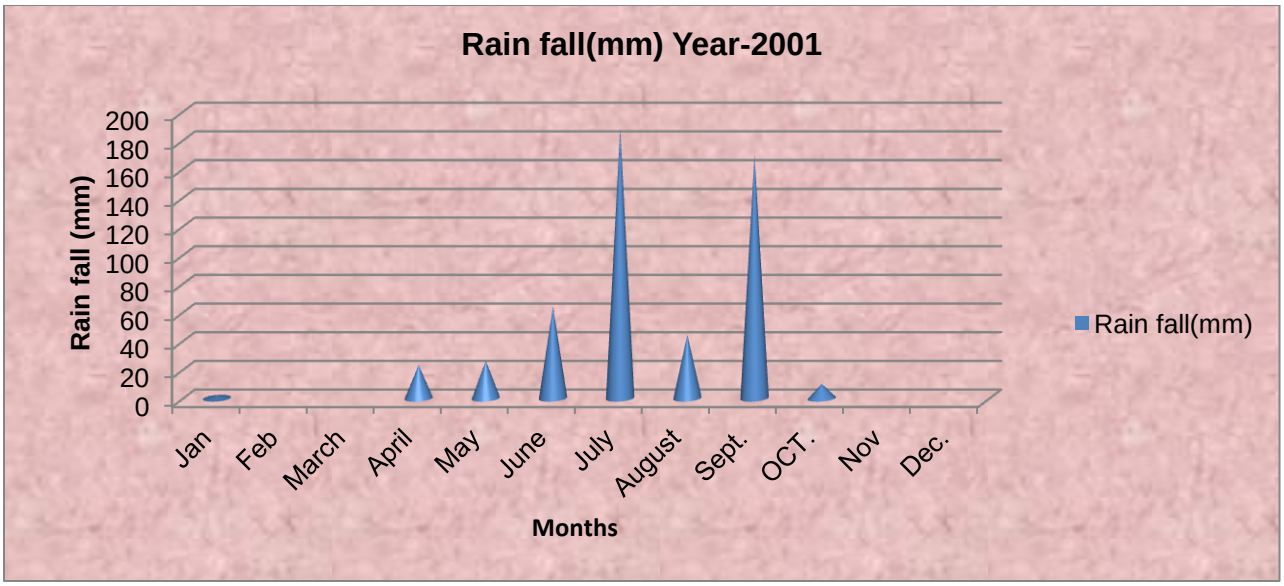

Fig 36: Monthly rain fall distribution

Temperature minimum and maximum: In the year 2001 the maximum temperature varied from 15.4 to 39.5 ^{o}c and minimum was ranged from 7.3 to 29.0 ^{o}c .

Relative humidity (%): The relative humidity in the year 2001 varied from 68.0 to 96.0%.

Rain fall (mm): The total precipitation in the year 2001 was recorded 428.3 mm and in the crop growth period it was recorded 418.3 mm.

Evaporation: The evaporation in the year 2001 ranged from 1.1 to 5.9 mm/day.

Water table: The water table position during the period from January 2001 to December 2001 is presented in table 36. It was variable in different months and varied from 7.1 to 8.6 m.

Table 37 : Effect of different treatments on pearl millet crop

Treatment	Year 2002				
	Grain Yield (kg/ha)	**Stover Yield (kg/ha)**	**Net Income (Rs/ha)**	**B:C Ratio**	**W U E (kg/ha-mm)**
T1 Control	--	--	--	--	--
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	--	--	--	--	--
T3 Half of he recommended dose of fertilizer	--	--	--	--	--
T4 50% N of the recommended dose to meet through farm residue	--	--	--	--	--
T5 50% N of the recommended dose to meet through FYM	--	--	--	--	--
T6 50% N through fertilizer + 50% N through farm residue	--	--	--	--	--
T7 50% N through fertilizer + 50% N through FYM	--	--	--	--	--
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	--	--	--	--	--
T9 Farmers method (10-15 kg N^{-1})	--	--	--	--	--
SEm $\pm$	--	--	--	--	--
CD at 5%	--	--	--	--	--
CV (%)	--	--	--	--	--
Actual Rainfall (mm) during the season	**542.6**	--	--	--	--
Rainfall (mm) during crop growth period	--	--	--	--	--

During kharif 2002, only 28.4 mm rains were received in the month of July. Hence experiment could not be shown

Table 38 Monthly meteorological observations recorded at R.B.S. College ,Bichpuri,Agra

Months	Temperature (0^C) Max.	Min..	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	19.6	7.2	83.0	24.4	1.1	8.9
February	23.2	9.4	81.0	42.6	1.2	8.9
March	31.	14.6	69.0	-	2.2	9.2
April	42.2	23.0	72.0	0.6	3.3	9.2
May	42.5	24.6	67.0	13.6	5.8	9.2
June	42.5	24.6	62.0	60.5	5.7	9.1
July	39.0	28.7	66.0	28.4	3.5	9.1
August	33.2	25.4	81.3	203.8	2.9	9.1
September	32.4	22.8	78.9	249.9	3.1	9.2
October	33.8	17.8	64.4	4.6	3.4	9.2
November	28.2	12.2	70.1	-	2.3	9.2
December	23.6	8.1	80.2	0.6	1.2	9.2

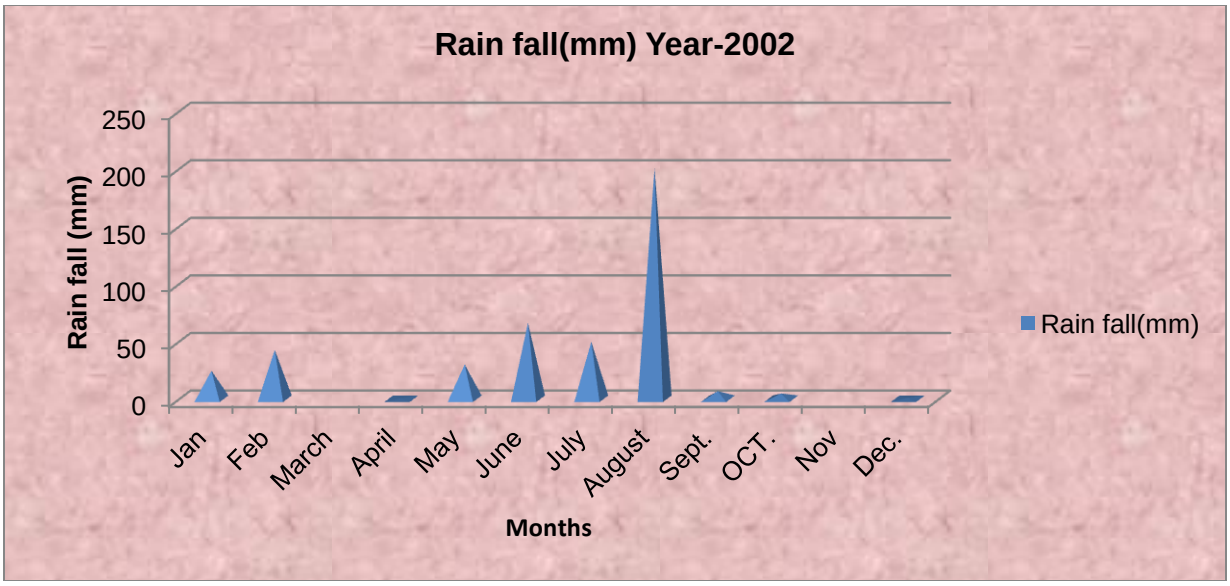

Fig 37:Monthly rain fall distribution

Temperature minimum and maximum: In the year 2002the maximum temperature varied from 19.6 to 42.5^{o}c and minimum was ranged from 7.2 to 28.7^{o}c .

Relative humidity (%): The relative humidity in the year 2002varied from 62.0 to 83.0%.

Rain fall (mm): The total precipitation during kharif 2002 was recorded 542.6 mm and in the crop growth period it was recorded 482.1 mm.

Evaporation: The evaporation in the year 2002 ranged from 1.1 to 5.8 mm/day.

Water table: The water table position during the period from January 2002 to December 2002 is presented in table 38. It was variable in different months and varied from 8.9 to 9.2m.

Table 39 : Effect of different treatments on pearl millet crop

Treatment	Year 2003		
	Grain Yield (kg/ha)	Stover Yield (kg/ha)	RW U E (kg/ha-mm)
T1 Control	1247	3242	3.42
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	2115	5100	5.81
T3 Half of he recommended dose of fertilizer	1610	3944	4.42
T4 50% N of the recommended dose to meet through farm residue	1682	4070	4.62
T5 50% N of the recommended dose to meet through FYM	1765	4236	4.85
T6 50% N through fertilizer + 50% N through farm residue	2185	5135	6.00
T7 50% N through fertilizer + 50% N through FYM	2225	5212	6.11
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	2200	5176	6.04
T9 Farmers method (10-15 kg N^{-1})	1379	3723	3.78
SEm ±	109	246	--
CD at 5%	364	821	--
CV (%)	11.8	11.1	--
Actual Rainfall (mm) during the season	**484.8**	--	--
Rainfall (mm) during crop growth period	**364.1**	--	--

The data on seed yield of pearl millet presented in table 39 and fig 39 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 2225 kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 6.11 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively.

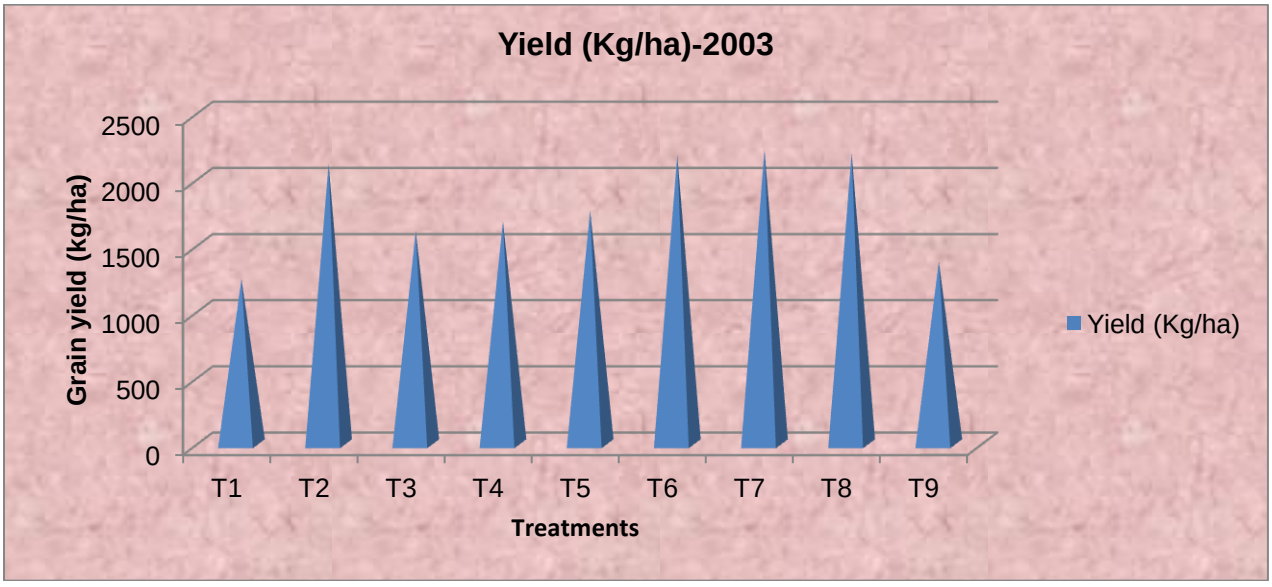

Fig 38: Pearl millet grain yield in different treatments

Table 40: Monthly meteorological observations recorded at R.B.S. College ,Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	13.7	4.7	93.7	19.3	1.1	9.2
February	26.8	6.5	83.8	7.0	1.9	9.2
March	32.9	9.7	64.8	0.6	3.5	9.3
April	40.7	17.5	34.0	-	6.1	9.4
May	42.5	22.4	28.0	11.4	7.7	9.4
June	43.2	24.7	47.8	36.0	6.2	9.4
July	34.1	25.7	84.6	389.6	3.2	10.4
August	32.7	24.8	90.1	54.2	2.5	9.8
September	31.1	24.1	92.4	2.8	1.8	9.8
October	32.7	16.6	68.0	-	3.0	9.7
November	27.6	11.3	70.8	-	2.2	10.3
December	23.3	9.0	82.7	.03	1.3	10.5

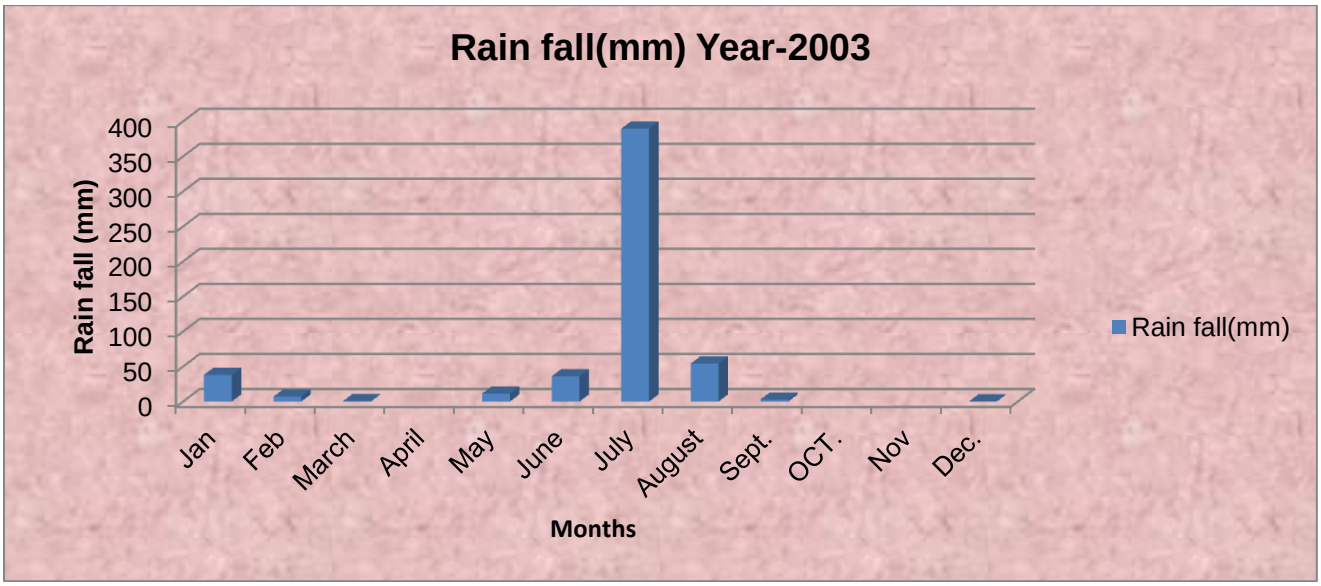

Fig 39: Monthly rain fall distribution

Temperature minimum and maximum: In the year 2003 the maximum temperature varied from 13.7 to 43.2 ^{o}c and minimum was ranged from 4.7 to 25.7^{o}c .

Relative humidity (%): The relative humidity in the year 2003 varied from 28.0 to 93.7%.

Rain fall (mm): The total precipitation during kharif 2003 was recorded 484.8 mm and in the crop growth period it was recorded 364.1 mm.

Evaporation: The evaporation in the year 2003 ranged from 1.1 to 7.7 mm/day.

Water table: The water table position during the period from January 2003 to December 2003 is presented in table 40. It was variable in different months and varied from 9.2 to 10.5m.

Table 41 : Effect of different treatments on pearl millet crop

Treatment	Year 2004		
	Grain Yield (kg/ha)	**Stover Yield (kg/ha)**	**W U E (kg/ha-mm)**
T1 Control	1338	3611	3.40
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	2675	5952	6.81
T3 Half of he recommended dose of fertilizer	2010	4784	5.11
T4 50% N of the recommended dose to meet through farm residue	2095	4828	5.33
T5 50% N of the recommended dose to meet through FYM	2110	4990	5.37
T6 50% N through fertilizer + 50% N through farm residue	2690	6148	6.85
T7 50% N through fertilizer + 50% N through FYM	2810	6319	7.15
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	2715	6071	6.91
T9 Farmers method (10-15 kg N^{-1})	1515	4014	3.85
SEm ±	142	342	--
CD at 5%	413	997	--
CV (%)	12.81	12.86	--
Actual Rainfall (mm) during the season	**497.7**	--	--
Rainfall (mm) during crop growth period	**392.9**	--	--

The data on seed yield of pearl millet presented in table 41and fig 40 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 2810kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 7.15 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively.

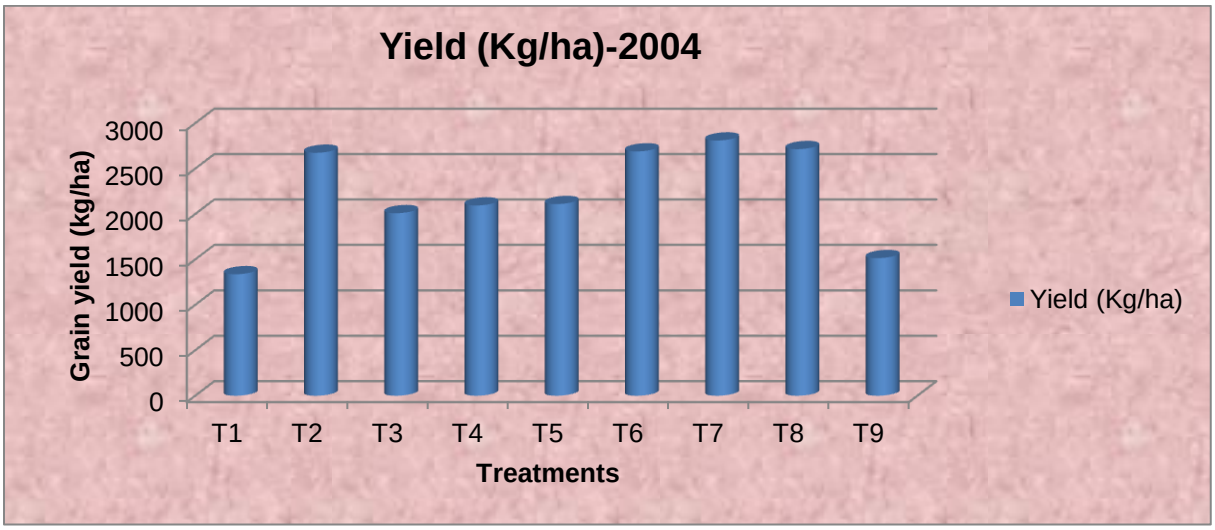

Fig 40: Pearl millet grain yield in different treatments

Table 42: Monthly meteorological observations recorded at R.B.S. College ,Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	12.5	7.8	94.6	-	0.7	9.9
February	24.7	7.6	81.3	-	2.2	10.4
March	33.7	13.4	59.1	-	3.8	10.7
April	38.2	19.4	33.5	-	6.3	10.7
May	40.1	25.8	38.9	12.2	7.4	10.7
June	37.9	26.5	57.5	23.6	5.4	10.7
July	37.6	26.5	78.0	120.1	3.4	10.8
August	33.7	25.9	87.0	309.8	2.6	10.6
September	34.8	23.8	81.0	27.8	2.1	10.4
October	32.4	19.1	81.0	54.5	3.2	10.5
November	303	11.4	85.0	.05	2.1	10.7
December	23.9	8.7	84.0	-	1.2	10.9

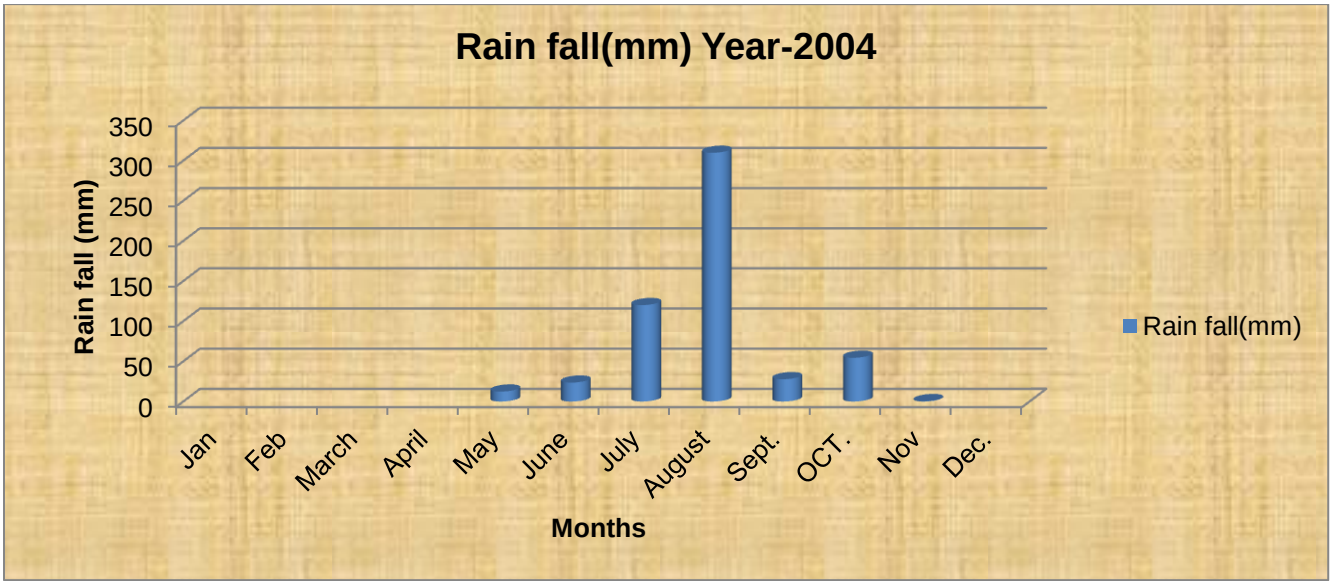

Fig 41: Monthly rain fall distribution

Temperature minimum and maximum: In the year 2004the maximum temperature varied from 12.5 to 40.1 ^{o}c and minimum was ranged from 7.6 to 26.5 ^{o}c .

Relative humidity (%): The relative humidity in the year 2004 varied from 33.5 to 94.6%.

Rain fall (mm): The total precipitation during kharif 2004 was recorded 497.7 mm and in the crop growth period it was recorded 392.9 mm.

Evaporation: The evaporation in the year 2004 ranged from 0.7 to 7.4 mm/day.

Water table: The water table position during the period from January 2004 to December 2004 is presented in table 42. It was variable in different months and varied from 9.9 to 10.9 m.

Table 43 : Effect of different treatments on pearl millet crop

Treatment	Year 2005		
	Grain Yield (kg/ha)	**Stover Yield (kg/ha)**	**W U E (kg/ha-mm)**
T1 Control	1224	3060	8.38
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	2442	4928	16.71
T3 Half of he recommended dose of fertilizer	1732	3862	11.85
T4 50% N of the recommended dose to meet through farm residue	1775	3816	12.15
T5 50% N of the recommended dose to meet through FYM	1824	4067	12.48
T6 50% N through fertilizer + 50% N through farm residue	2476	5152	16.94
T7 50% N through fertilizer + 50% N through FYM	2682	5739	18.35
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	2542	5063	17.40
T9 Farmers method (10-15 kg N^{-1})	1310	3242	8.97
SEm ±	103	219	--
CD at 5%	303	638	--
CV (%)	10.35	10.13	--
Actual Rainfall (mm) during the season	**628.8**	--	--
Rainfall (mm) during crop growth period	**145.3**	--	--

The data on seed yield of pearl millet presented in table 43and fig 42 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 2682 kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 18.35 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively.

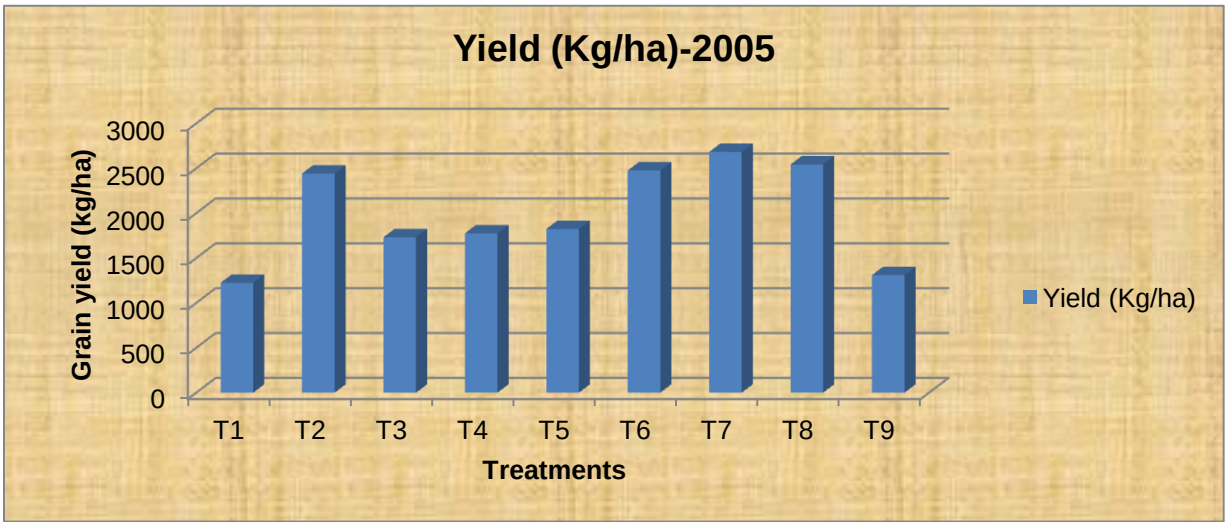

Table 44: Monthly meteorological observations recorded at R.B.S. College ,Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	20.5	6.1	95.0	0.8	1.1	11.2
February	23.4	9.5	94.0	-	1.3	11.2
March	31.4	15.1	85.0	18.8	23	11.4
April	38.1	18.0	81.0	.05	3.5	11.4
May	40.8	22.6	57.0	6.8	5.9	11.4
June	43.8	27.3	45.0	10.2	2.8	11.2
July	31.3	25.6	70.0	479.3	2.0	11.0
August	33.8	25.9	71.0	100.3	5.2	11.0
September	35.2	24.7	76.0	45.0	4.4	11.2
October	31.2	18.6	74.0	-	4.3	11.2
November	30.8	12.2	83.0	-	2.7	11.3
December	22.4	7.2	94.0	-	1.8	11.2

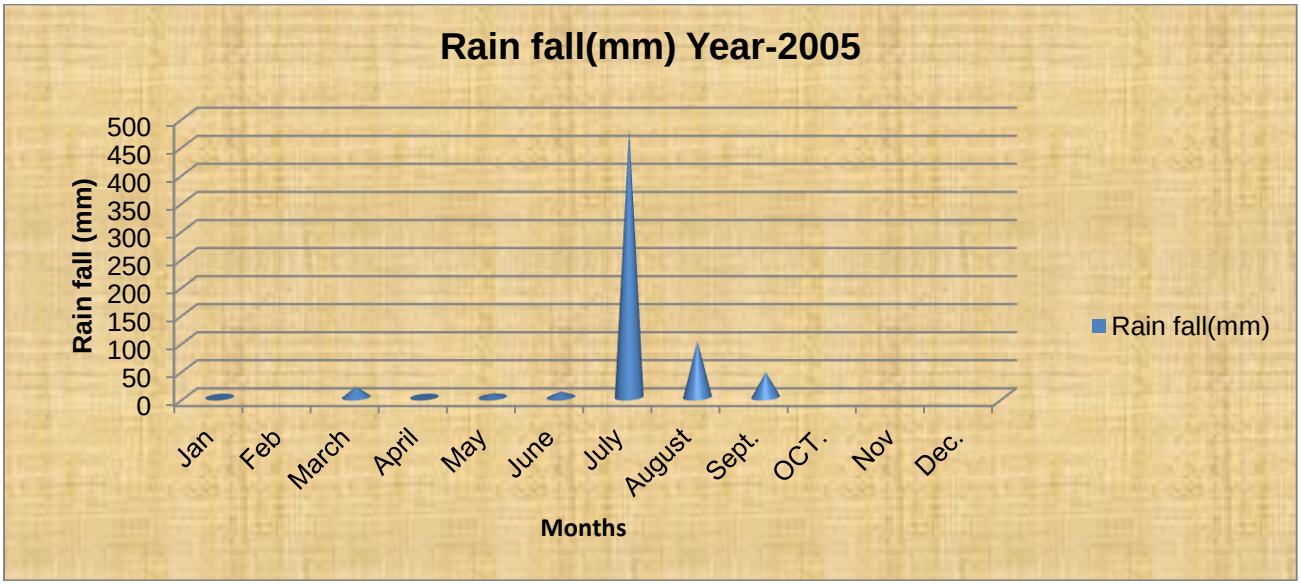

Fig 43: Monthly rain fall distribution

Temperature minimum and maximum: In the year 2005 the maximum temperature varied from 20.5 to 43.8 ^{o}c and minimum was ranged from 6.1 to 27.3 ^{o}c .

Relative humidity (%): The relative humidity in the year 2005 varied from 45.0 to 95.0%.

Rain fall (mm): The total precipitation during kharif 2005 was recorded 628.8mm and in the crop growth period it was recorded 145.3 mm.

Evaporation: The evaporation in the year 2005 ranged from 1.1 to 5.9 mm/day.

Water table: The water table position during the period from January 2005 to December 2005 is presented in table 44. It was variable in different months and varied from 11.0 to 11.4 m.

Table 45 : Effect of different treatments on pearl millet crop

Treatment	Year 2006		
	Grain Yield (kg/ha)	Stover Yield (kg/ha)	W U E (kg/ha-mm)
T1 Control	410	1107	2.22
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	1109	2695	6.01
T3 Half of he recommended dose of fertilizer	1025	2511	5.56
T4 50% N of the recommended dose to meet through farm residue	725	1870	3.93
T5 50% N of the recommended dose to meet through FYM	1090	2769	5.91
T6 50% N through fertilizer + 50% N through farm residue	1222	2957	6.62
T7 50% N through fertilizer + 50% N through FYM	1382	3289	7.49
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	1132	2751	6.14
T9 Farmers method (10-15 kg N^{-1})	680	1775	3.68
SEm ±	123	194	--
CD at 5%	358	564	--
CV (%)	21.48	16.07	--
Actual Rainfall (mm) during the season	**330.0**	--	--
Rainfall (mm) during crop growth period	**184.5**	--	--

The data on seed yield of pearl millet presented in table 45 and fig 44 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 1382 kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 7.49 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively.

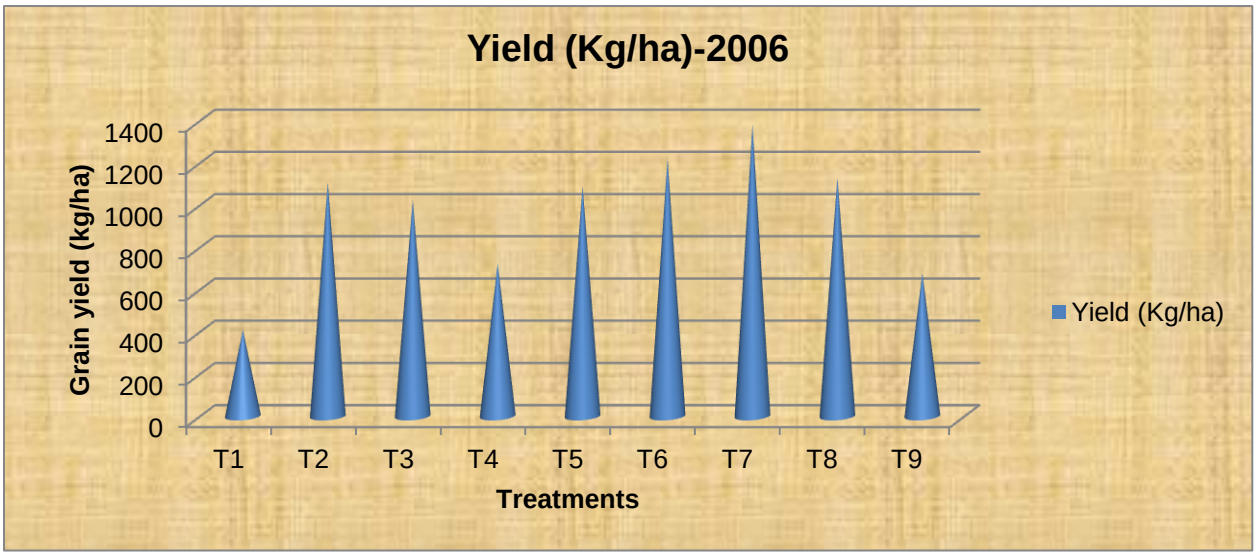

Fig 44: Pearl millet grain yield in different treatments

Table 46: Monthly meteorological observations recorded at R.B.S. College ,Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	22.2	5.3	95.0	-	1.8	10.8
February	25.8	16.7	94.0	-	2.4	11.1
March	30.7	15.3	83.0	7.0	4.5	11.2
April	38.6	21.9	81.0	0.2	8.4	11.2
May	40.6	26.9	84.0	43.3	8.1	11.3
June	39.9	28.2	83.0	11.7	7.8	11.2
July	34.2	27.5	81.0	306.2	4.0	11.5
August	33.8	26.4	82.7	43.8	5.2	11.3
September	36.1	24.9	82.7	14.3	5.8	11.9
October	34.9	21.1	83.0	1.5	6.0	12.0
November	30.6	15.5	83.5	-	3.0	12.3
December	24.2	8.0	83.5	3.8	2.0	12.3

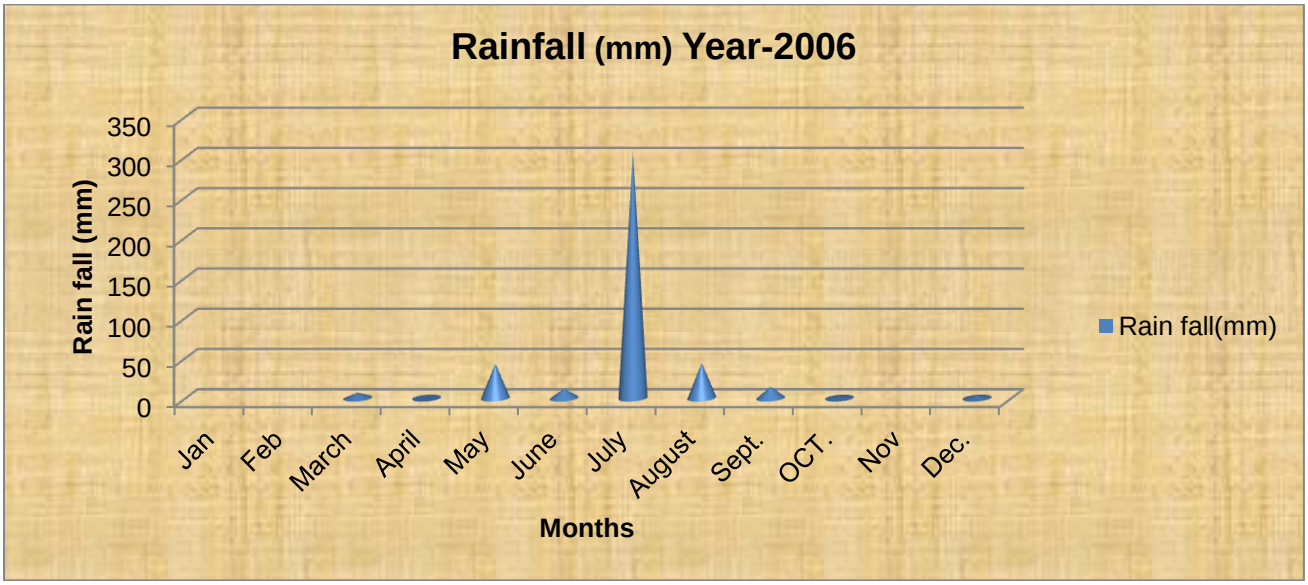

Fig 45: Monthly rain fall distribution

Temperature minimum and maximum: In the year 2006 the maximum temperature varied from 22.2 to 40.6 ^{o}c and minimum was ranged from 5.3 to 28.2 ^{o}c .

Relative humidity (%): The relative humidity in the year 2006 varied from 81.0 to 95.0%.

Rain fall (mm): The total precipitation during kharif 2006 was recorded 330.0 mm and in the crop growth period it was recorded 184.5 mm.

Evaporation: The evaporation in the year 2006 ranged from 1.8 to 8.4 mm/day.

Water table: The water table position during the period from January 2006 to December 2006 is presented in table 46. It was variable in different months and varied from 10.8 to 12.3 m.

Table 47 : Effect of different treatments on pearl millet crop

Treatment	Year 2007				
	Grain Yield (kg/ha)	Stover Yield (kg/ha)	Net Income (Rs/ha)	B:C Ratio	W U E (kg/ha-mm)
T1 Control	730	1898	(-) 62	0.99	3.33
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	1640	3690	6942	1.80	7.49
T3 Half of he recommended dose of fertilizer	1210	2746	3543	1.44	5.55
T4 50% N of the recommended dose to meet through farm residue	1250	3062	3395	1.38	5.71
T5 50% N of the recommended dose to meet through FYM	1340	3009	3864	1.43	6.12
T6 50% N through fertilizer + 50% N through farm residue	1764	4233	8156	1.91	8.05
T7 50% N through fertilizer + 50% N through FYM	1897	4363	9356	1.94	8.66
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	1828	4295	8719	1.93	8.35
T9 Farmers method (10-15 kg N^{-1})	969	2480	2090	1.28	4.42
SEm ±	96	230	--	--	--
CD at 5%	278	668	--	--	--
CV (%)	13.63	13.88	--	--	--
Actual Rainfall (mm) during the season	**304.2**	--	--	--	--
Rainfall (mm) during crop growth period	**218.0**	--	--	--	--

The data on seed yield of pearl millet presented in table 47 and fig 46 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 1897 kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 8.66 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively**.**

The data on gross monitory return as influenced by organic and inorganic fertilizer sources under different treatments are given in table indicate that amongst the treatment T7 i.e. 50% N of RDF through FYM + 50% N meet through inorganic fertilizer had higher net return (of Rs. 9356/- and BC ratio of 1.94, while the lowest BC ratio was recorded in control treatment 0.99

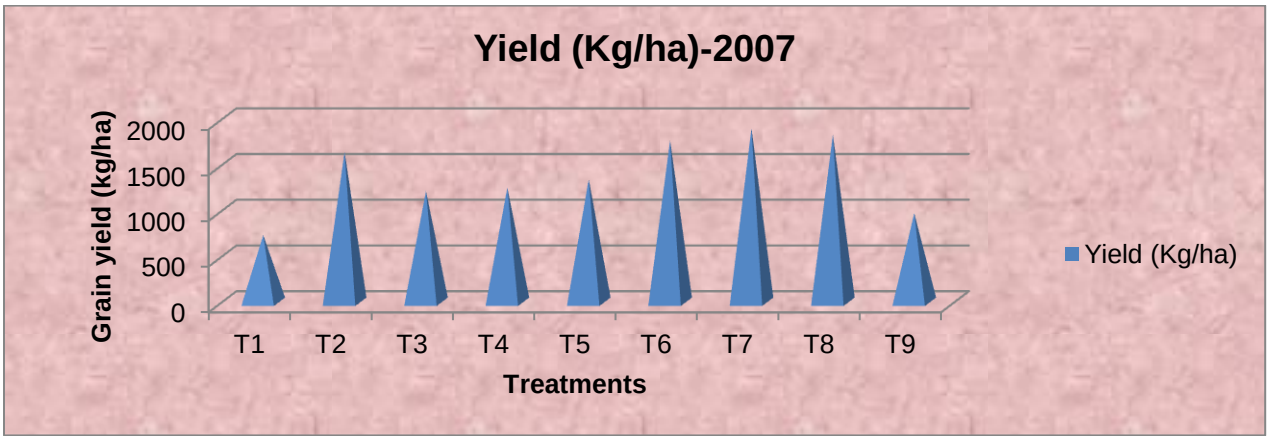

Fig 46: Pearl millet grain yield in different treatments

Table 48: Monthly meteorological observations recorded at R.B.S. College ,Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	23.5	6.9	83.1	-	2.0	12.4
February	24.6	12.9	93.0	69.0	2.0	11.6
March	30.2	15.6	88.0	62.1	4.0	11.9
April	39.5	22.9	85.2	2.2	8.0	12.2
May	41.7	27.3	85.0	-	9.0	12.3
June	39.3	28.8	81.5	86.2	7.0	12.2
July	35.1	27.0	86.0	70.4	4.0	11.9
August	34.0	26.1	90.0	130.1	4.0	11.8
September	34.5	24.8	88.0	17.5	4.0	12.2
October	35.1	18.0	73.0	-	5.0	12.4
November	31.3	14.0	84.0	-	3.0	12.4
December	24.3	8.0	93.0	1.3	1.0	12.5

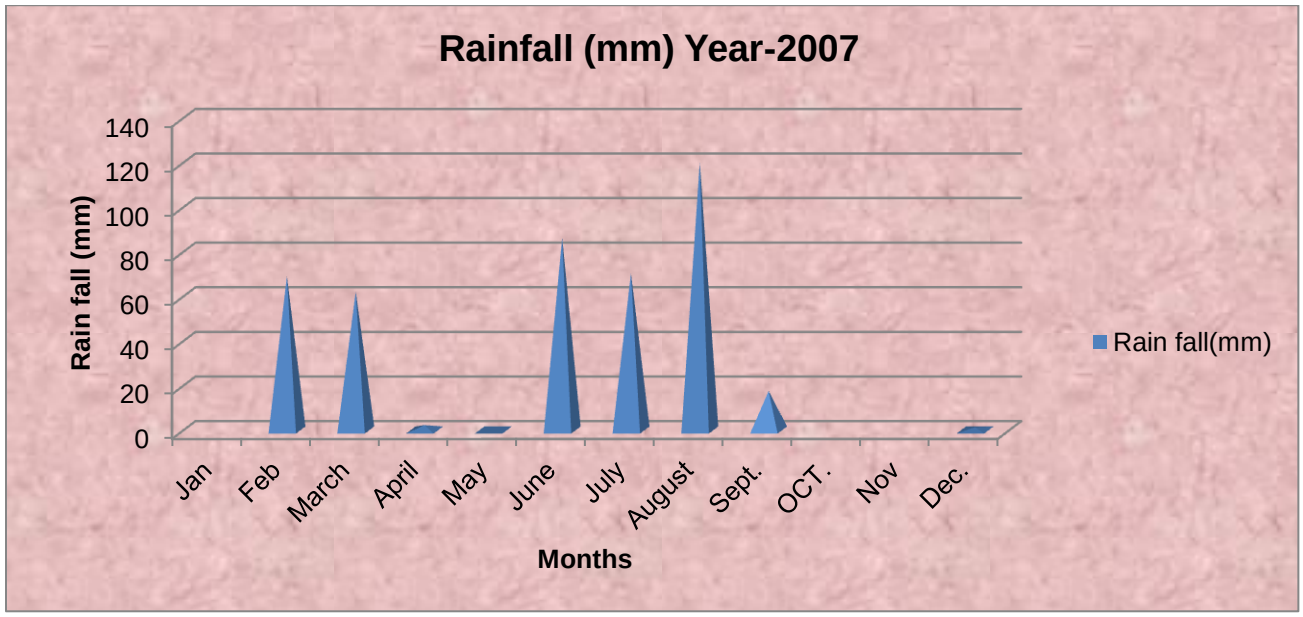

Fig 47: Monthly rain fall distribution

Temperature minimum and maximum: In the year 2007 the maximum temperature varied from 23.5 to 41.7 ^{o}c and minimum was ranged from 6.9 to 28.8 ^{o}c .

Relative humidity (%): The relative humidity in the year 2007 varied from 73.0 to 93.0 %.

Rain fall (mm): The total precipitation during kharif 2007 was recorded 304.2 mm and in the crop growth period it was recorded 218.0 mm.

Evaporation: The evaporation in the year 2007 ranged from 1.0 to 9.0 mm/day.

Water table: The water table position during the period from January 2007 to December 2007 is presented in table 48. It was variable in different months and varied from 11.6 to 12.5 m.

Table 49 : Effect of different treatments on pearl millet crop

Treatment	Year 2008				
	Grain Yield (kg/ha)	Stover Yield (kg/ha)	Net Income (Rs/ha)	B:C Ratio	W U E (kg/ha-mm)
T1 Control	1726	4290	5501	1.53	2.66
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	2940	6476	14460	2.23	4.55
T3 Half of he recommended dose of fertilizer	2348	5437	10137	1.91	3.59
T4 50% N of the recommended dose to meet through farm residue	2310	5458	9831	1.88	3.57
T5 50% N of the recommended dose to meet through FYM	2380	5525	10485	1.95	3.68
T6 50% N through fertilizer + 50% N through farm residue	2810	6200	13230	2.91	4.34
T7 50% N through fertilizer + 50% N through FYM	3075	6849	15791	2.35	4.75
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	2990	6641	14267	2.14	4.62
T9 Farmers method (10-15 kg N^{-1})	2056	4997	7907	1.72	3.18
SEm ±	127	298	--	--	--
CD at 5%	369	869	--	--	--
CV (%)	10.08	10.35	--	--	--
Actual Rainfall (mm) during the season	**758.1**	--	--	--	--
Rainfall (mm) during crop growth period	**646.8**	--	--	--	--

The data on seed yield of pearl millet presented in table 49 and fig 48 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 3075kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 4.75 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively.

The data on gross monitory return as influenced by organic and inorganic fertilizer sources under different treatments are given in table indicate that amongst the treatment T7 i.e. 50% N of RDF through FYM + 50% N meet through inorganic fertilizer had higher net return (of Rs. 15,791/- and BC ratio of 2.35, while the lowest BC ratio was recorded in control treatment 1.53

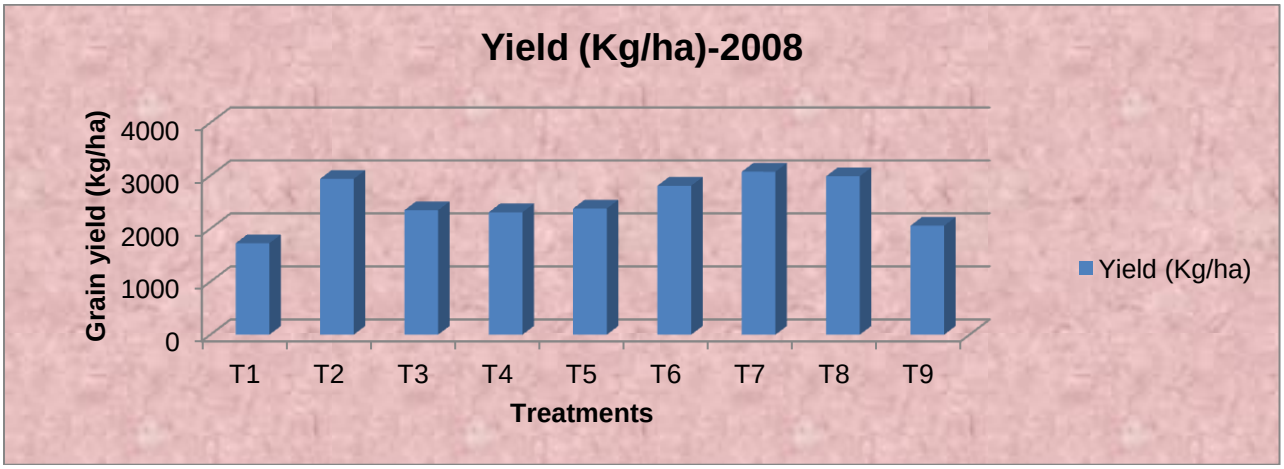

Fig 48: Pearl millet grain yield in different treatments

Table 50: Monthly meteorological observations recorded at R.B.S. College ,Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	21.1	6.3	91.0	-	1.0	12.7
February	22.1	7.2	84.0	-	1.0	12.8
March	33.8	15.6	75.0	-	3.1	12.8
April	38.5	21.6	59.0	10.6	8.0	12.2
May	39.9	24.4	40.0	45.1	7.1	12.0
June	35.8	24.7	71.0	147.5	5.2	11.6
July	35.9	24.8	70.7	110.1	4.5	13.6
August	32.9	26.0	91.8	120.3	3.8	13.5
September	33.7	25.5	92.4	226.8	3.4	13.6
October	34.8	20.4	89.0	151.3	3.5	13.6
November	29.7	14.5	85.5	-	3.1	13.8
December	25.1	9.9	89.5	-	1.4	13.7

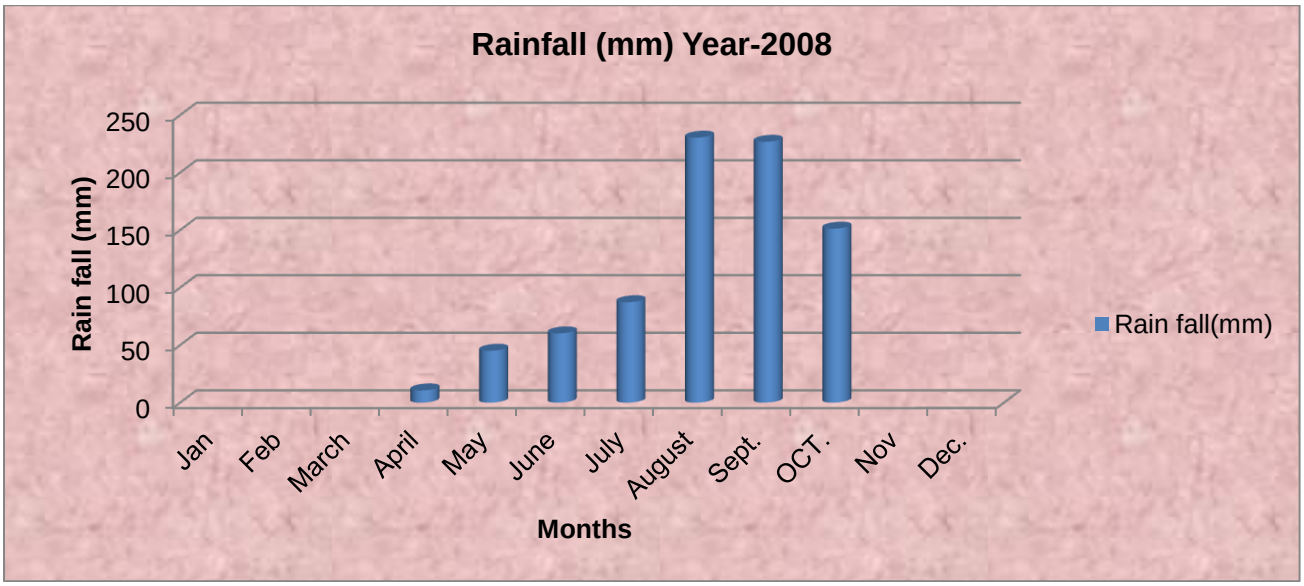

Fig 49 : Monthly rainfall distribution

Temperature minimum and maximum: In the year 2008 the maximum temperature varied from 21.1 to 39.9 ^{o}c and minimum was ranged from 6.3 to 26.0 ^{o}c .

Relative humidity (%): The relative humidity in the year 2008 varied from 40.0 to 92.4 %.

Rain fall (mm): The total precipitation during kharif 2008 was recorded 758.1 mm and in the crop growth period it was recorded 646.8 mm.

Evaporation: The evaporation in the year 2008 ranged from 1.0 to 8.0 mm/day.

Water table: The water table position during the period from January 2008 to December 2008 is presented in table 50. It was variable in different months and varied from 11.6 to13.8 m.

Table 51 : Effect of different treatments on pearl millet crop

Treatment	Year 2009				
	Grain Yield (kg/ha)	Stover Yield (kg/ha)	Net Income (Rs/ha)	B:C Ratio	W U E (kg/ha-mm)
T1 Control	1810	4400	9358	1.94	5.31
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	3390	6600	23082	3.04	9.94
T3 Half of he recommended dose of fertilizer	2610	5510	16311	2.60	7.65
T4 50% N of the recommended dose to meet through farm residue	2545	5500	14948	2.30	7.46
T5 50% N of the recommended dose to meet through FYM	2640	5760	16244	2.45	7.74
T6 50% N through fertilizer + 50% N through farm residue	3200	6340	20983	2.81	9.38
T7 50% N through fertilizer + 50% N through FYM	3415	6830	23492	3.07	10.01
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	3365	6610	22693	2.97	9.86
T9 Farmers method (10-15 kg N^{-1})	2200	5020	12993	2.28	6.45
SEm ±	159	364	--	--	--
CD at 5%	465	1060	--	--	--
CV (%)	11.40	12.48	--	--	--
Actual Rainfall (mm) during the season	**379.4**	--	--	--	--
Rainfall (mm) during crop growth period	**341.1**	--	--	--	--

The data on seed yield of pearl millet presented in table 51and fig 50 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 3415 kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 10.01 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively**.**

The data on gross monitory return as influenced by organic and inorganic fertilizer sources under different treatments are given in table indicate that amongst the treatment T7 i.e. 50% N of RDF through FYM + 50% N meet through inorganic fertilizer had higher net return (of Rs. 23,492/- and BC ratio of 3.07, while the lowest BC ratio was recorded in control treatment 1.94

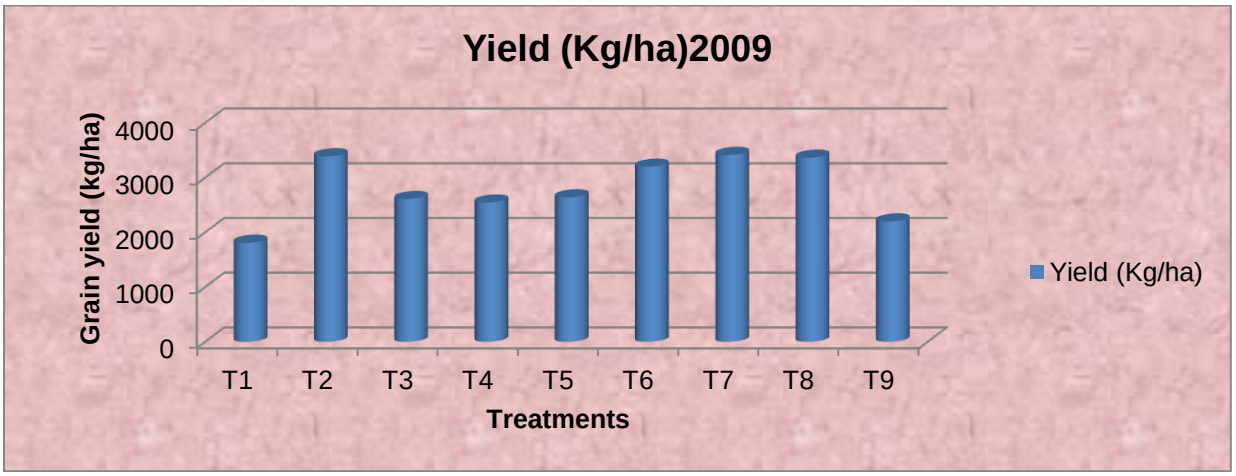

Fig 50: Pearl millet grain yield in different treatments

Table 52: Monthly meteorological observations recorded at R.B.S. College ,Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity (%)	Rain fall (mm)	Evaporation (mm/day)	Water table (m)
January	22.4	8.8	91.6	-	1.1	13.8
February	26.9	10.9	89.6	-	2.3	13.9
March	33.3	16.2	75.1	-	4.2	13.9
April	38.3	21.4	54.1	7.2	8.5	13.9
May	40.9	25.6	54.6	25.6	8.0	13.9
June	39.9	27.8	62.7	-	1.1	13.9
July	34.1	27.5	84.3	116.3	4.5	13.9
August	34.0	33.8	82.3	191.1	4.6	14.0
September	32.3	24.2	86.7	70.5	3.9	14.3
October	31.9	18.7	80.6	139.9	3.1	14.2
November	26.5	12.5	85.2	26.1	1.6	14.4
December	23.3	7.3	89.5	6.8	1.1	14.4

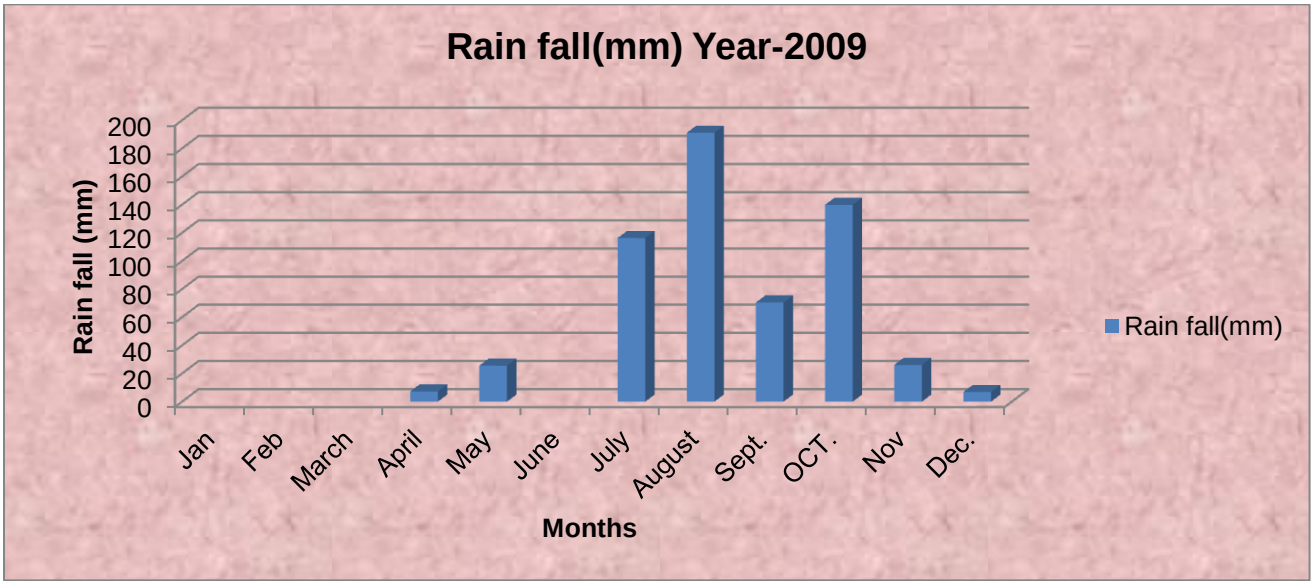

Fig 51: Monthly rain fall distribution

Temperature minimum and maximum: In the year 2009 the maximum temperature varied from 22.4 to 40.9 ^{o}c and minimum was ranged from 7.3 to 33.8 ^{o}c .
Relative humidity (%): The relative humidity in the year 2009 varied from 54.1 to 91.6 %.
Rain fall (mm): The total precipitation during kharif 2009 was recorded 379.4 mm and in the crop growth period it was recorded 341.1mm.
Evaporation: The evaporation in the year 2009 ranged from 1.1 to 8.5 mm/day.
Water table: The water table position during the period from January 2009 to December 2009 is presented in table 52. It was variable in different months and varied from 13.8 to 14.4 m.

Table 53 : Effect of different treatments on pearl millet crop

Treatment	Year 2010				
	Grain Yield (kg/ha)	Stover Yield (kg/ha)	Net Income (Rs/ha)	B:C Ratio	W U E (kg/ha-mm)
T1 Control	1652	3138	7,973	1.70	3.16
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	2945	5890	23,149	2.75	5.70
T3 Half of he recommended dose of fertilizer	2425	4559	16,303	2.36	4.64
T4 50% N of the recommended dose to meet through farm residue	2381	4490	14,470	2.12	4.56
T5 50% N of the recommended dose to meet through FYM	2440	4610	15,818	2.25	4.67
T6 50% N through fertilizer + 50% N through farm residue	3026	6021	22,053	2.62	5.80
T7 50% N through fertilizer + 50% N through FYM	3253	6668	22,175	2.88	6.23
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	3105	6210	23,754	2.84	4.03
T9 Farmers method (10-15 kg N^{-1})	1825	3504	9,805	1.85	3.50
SEm ±	146	175	-	-	-
CD at 5%	425	525	-	-	-
CV (%)	11.37	13.25	-	-	-
Actual Rainfall (mm) during the season	**642.2**	--	-	-	-
Rainfall (mm) during crop growth period	**522.1**	--	-	-	-

The data on seed yield of pearl millet presented in table 53 and fig 52 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 3253kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 6.23 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively.

The data on gross monitory return as influenced by organic and inorganic fertilizer sources under different treatments are given in table indicate that amongst the treatment T7 i.e. 50% N of RDF through FYM + 50% N meet through inorganic fertilizer had higher net return (of Rs. 22,175/- and BC ratio of 2.88 while the lowest BC ratio was recorded in control treatment 1.70.

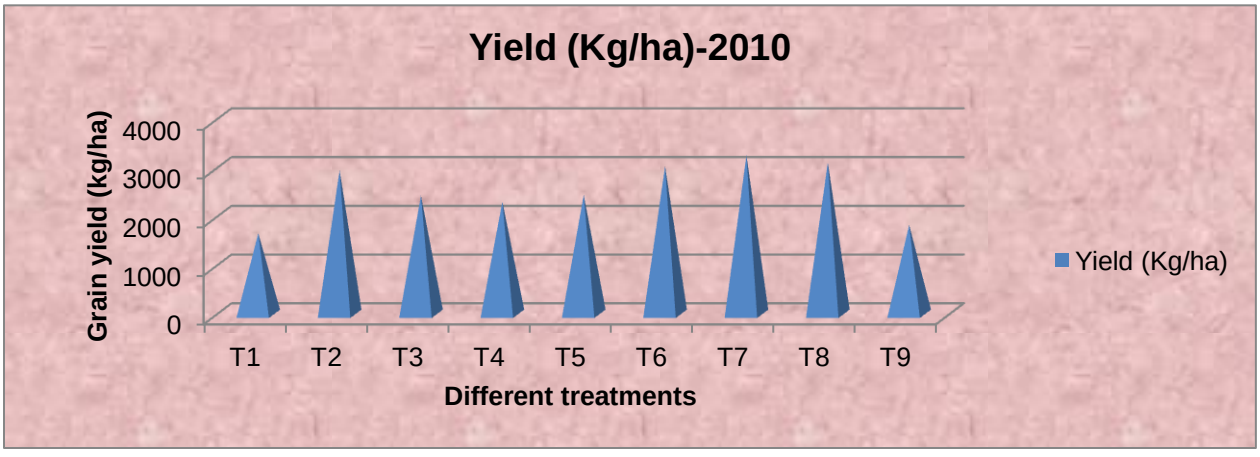

Fig 52: Pearl millet grain yield in different treatments

Table 54: Monthly meteorological observations recorded at R.B.S. College ,Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	19.4	5.9	89.4	8.3	1.0	12.5
February	27.2	10.5	89.4	13.8	1.4	14.5
March	33.2	13.9	75.2	-	4.7	14.7
April	39.3	21.3	52.3	-	8.8	14.7
May	41.1	26.6	53.9	5.6	9.5	14.8
June	39.3	27.5	62.5	33.2	8.5	12.1
July	33.3	28.3	84.7	75.0	4.0	11.8
August	32.0	26.8	86.2	248.7	3.0	11.6
September	30.3	24.7	78.5	226.9	3.1	12.2
October	32.8	20.1	64.8	-	4.0	12.8
November	27.5	15.8	70.3	27.0	2.0	12.7
December	23.9	6.7	74.2	6.0	1.0	12.7

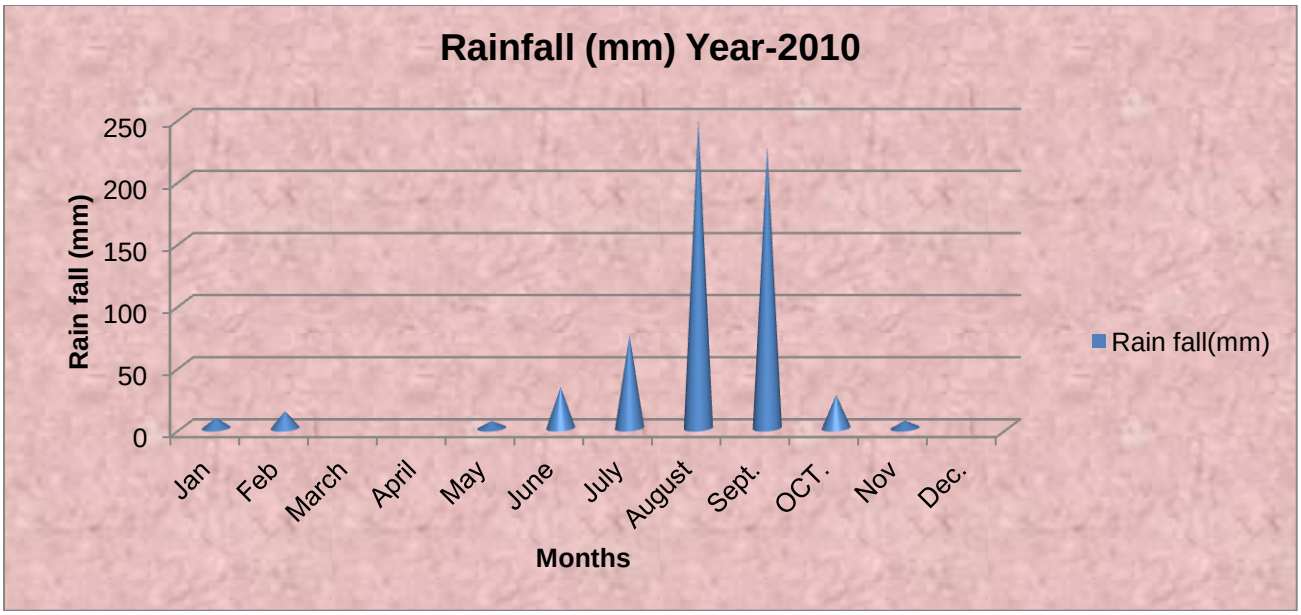

Fig 53: Monthly rain fall distribution

Temperature minimum and maximum: In the year 2010 the maximum temperature varied from 19.4 to 41.1 ^{o}c and minimum was ranged from 5.9 to 28.3 ^{o}c .

Relative humidity (%): The relative humidity in the year 2010 varied from 52.3 to 89.4 %.

Rain fall (mm): The total precipitation during kharif 2010 was recorded 642.2 mm and in the crop growth period it was recorded 522.1 mm.

Evaporation: The evaporation in the year 2010 ranged from 1.0 to 9.5 mm/day.

Water table: The water table position during the period from January 2010 to December 2010 is presented in table 54. It was variable in different months and varied from 11.6 to 14.7 m.

Table 55: Effect of different treatments on pearl millet crop

Treatment	Year 2011				
	Grain Yield (kg/ha)	Stover Yield (kg/ha)	Net Income (Rs/ha)	B:C Ratio	W U E (kg/ha-mm)
T1 Control	1516	3571	3687	1.25	3.31
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	3220	6086	21272	2.30	7.03
T3 Half of he recommended dose of fertilizer	2615	5334	15402	1.99	5.71
T4 50% N of the recommended dose to meet through farm residue	2565	5438	14068	1.85	5.60
T5 50% N of the recommended dose to meet through FYM	2642	5495	15140	1.93	5.77
T6 50% N through fertilizer + 50% N through farm residue	3233	6143	20507	2.18	7.06
T7 50% N through fertilizer + 50% N through FYM	3675	7129	26085	2.53	8.02
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	3494	6638	23734	2.38	7.63
T9 Farmers method (10-15 kg N^{-1})	1815	3920	6666	1.44	3.96
SEm ±	148	334	--	--	--
CD at 5%	432	972	--	--	--
CV (%)	10.78	12.07	--	--	--
Actual Rainfall (mm) during the season	**635.9**	--	--	--	--
Rainfall (mm) during crop growth period	**457.8**	--	--	--	--

The data on seed yield of pearl millet presented in table 55 and fig 54 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 3675 kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 8.02 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively.

The data on gross monitory return as influenced by organic and inorganic fertilizer sources under different treatments are given in table indicate that amongst the treatment T7 i.e. 50% N of RDF through FYM + 50% N meet through inorganic fertilizer had higher net return (of Rs. 26,085/- and BC ratio of 2.53, while the lowest BC ratio was recorded in control treatment 1.25

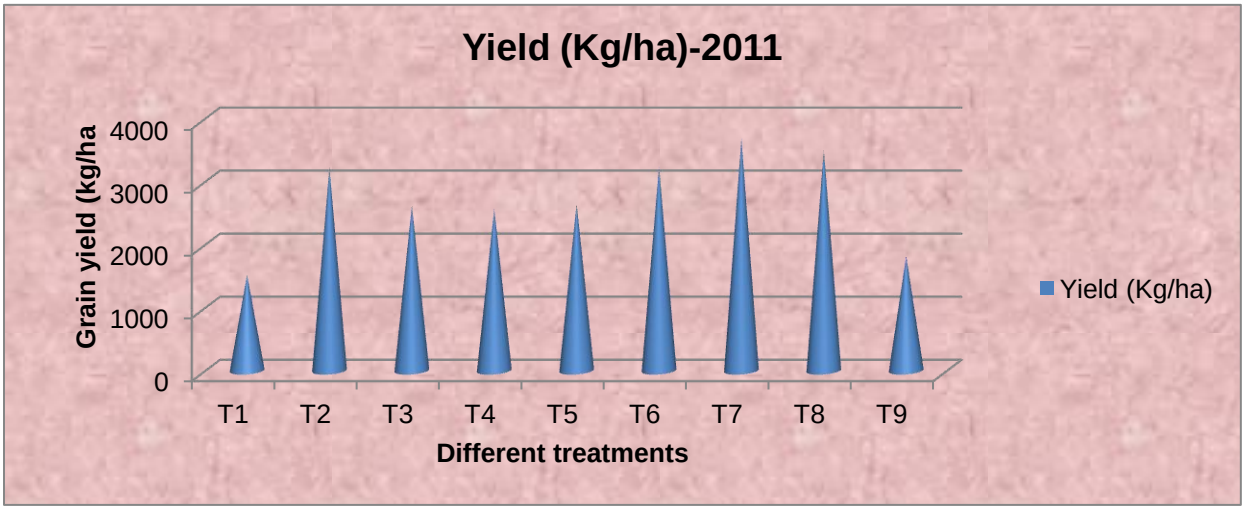

Fig 54: Pearl millet grain yield in different treatments

Table 56: Monthly meteorological observations recorded at R.B.S. College ,Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	19.1	3.0	77.5	-	1.0	12.2
February	24.3	7.3	77.1	32.5	2.0	12.2
March	29.4	12.5	64.8	0.9	4.0	12.5
April	35.8	18.5	43.9	6.0	6.0	12.2
May	38.8	26.1	43.7	20.1	8.0	12.0
June	37.5	26.6	61.6	142.9	10.4	11.8
July	33.9	26.4	75.7	167.7	3.2	14.5
August	33.1	26.3	69.5	177.5	2.2	14.4
September	33.1	25.2	71.7	69.9	4.7	14.6
October	32.2	16.3	71.6	-	4.9	14.3
November	30.1	12.6	71.4	-	2.4	15.0
December	23.3	7.7	78.9	-	1.3	16.0

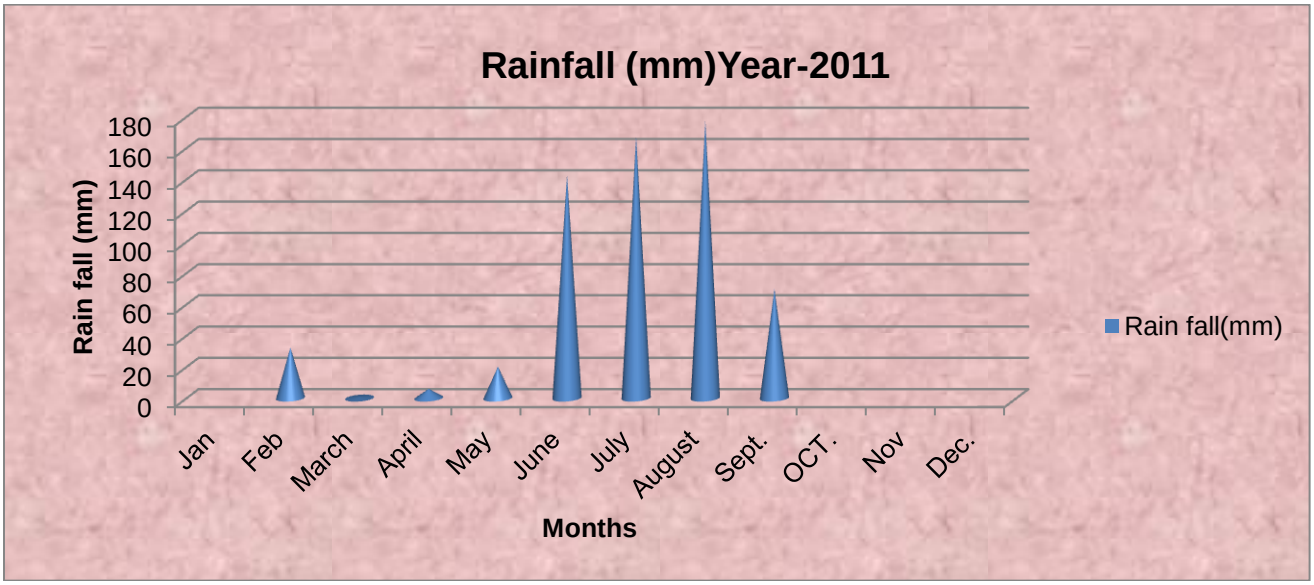

Fig 55: Monthly rain fall distribution

Temperature minimum and maximum: In the year 2011 the maximum temperature varied from 19.1 to 38.8 ^{o}c and minimum was ranged from 3.0 to 26.6 ^{o}c .

Relative humidity (%): The relative humidity in the year 2011 varied from 43.7 to 78.9 %.

Rain fall (mm): The total precipitation during kharif 2011 was recorded 635.9 mm and in the crop growth period it was recorded 457.8 mm.

Evaporation: The evaporation in the year 2011 ranged from 1.0 to 10.4 mm/day.

Water table: The water table position during the period from January 2011 to December 2011 is presented in table 56. It was variable in different months and varied from 11.8 to 16.0 m.

Table 57 : Effect of different treatments on pearl millet crop

Treatment	Year 2012				
	Grain Yield (kg/ha)	Stover Yield (kg/ha)	Net Income (Rs/ha)	B:C Ratio	W U E (kg/ha-mm)
T1 Control	1250	4062	2,846	1.20	2.14
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	2468	6020	15,075	1.73	4.22
T3 Half of he recommended dose of fertilizer	1780	4717	8,263	0.56	3.04
T4 50% N of the recommended dose to meet through farm residue	1840	5042	7,866	1.48	3.15
T5 50% N of the recommended dose to meet through FYM	1910	5272	8.171	1.50	3.17
T6 50% N through fertilizer + 50% N through farm residue	2485	6958	16,210	1.98	4.25
T7 50% N through fertilizer + 50% N through FYM	2678	72300	18,324	2.10	4.58
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	2535	6591	15,034	1.92	4.33
T9 Farmers method (10-15 kg N^{-1})	1515	4469	5,721	1.39	2.59
SEm ±	143	402	-	-	-
CD at 5%	418	1172	-	-	-
CV (%)	13.98	14.37	-	-	-
Actual Rainfall (mm) during the season	**679.7**	---	-	-	-
Rainfall (mm) during crop growth period	**584.5**	---	-	-	-

The data on seed yield of pearl millet presented in table 57 and fig 56 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 2678 kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 4.58 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively**.**

The data on gross monitory return as influenced by organic and inorganic fertilizer sources under different treatments are given in table indicate that amongst the treatment T7 i.e. 50% N of RDF through FYM + 50% N meet through inorganic fertilizer had higher net return (of Rs. 18,324/- and BC ratio of 2.10, while the lowest BC ratio was recorded in control treatment 1.20

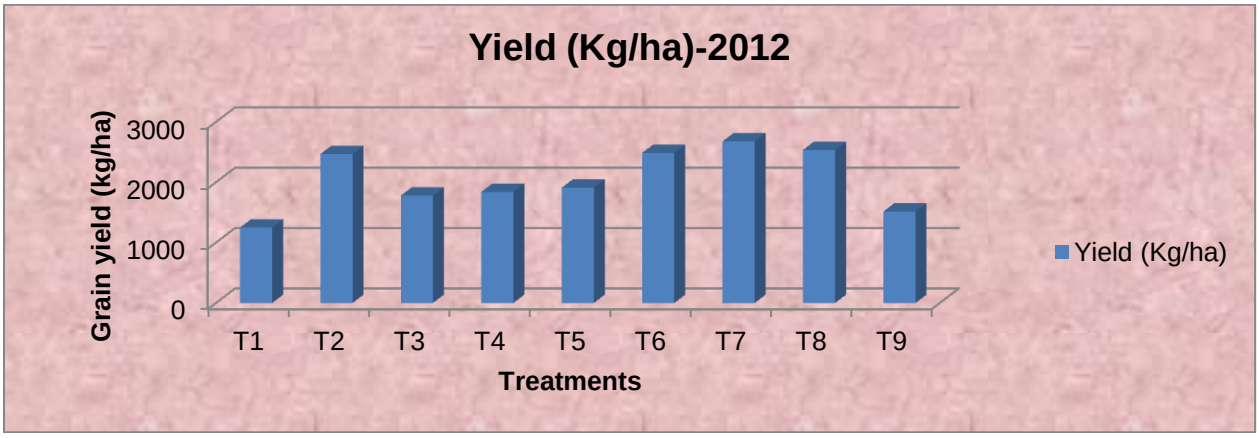

Fig 56: Pearl millet grain yield in different treatments

Table 58: Monthly meteorological observations recorded at R.B.S. College ,Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	19.4	6.1	48.6	33.5	2.4	15.8
February	23.5	7.2	75.5	-	2.1	16.0
March	27.6	10.0	70.9	-	3.1	14.6
April	34.8	185	61.6	-.3	6.6	14.1
May	41.8	24.8	40.2	-	11.2	16.8
June	38.5	26.7	44.6	7.2	10.5	17.1
July	31.7	25.3	78.2	199.5	5.5	16.5
August	33.6	258	90.9	325.7	3.2	16.4
September	33.8	25.3	85.9	149.3	3.0	16.3
October	31.9	17.3	76.0	-	4.2	16.3
November	29.6	13.2	85.9	-	1.9	17.3
December	30.2	12.9	77.1	-	1.6	17.4

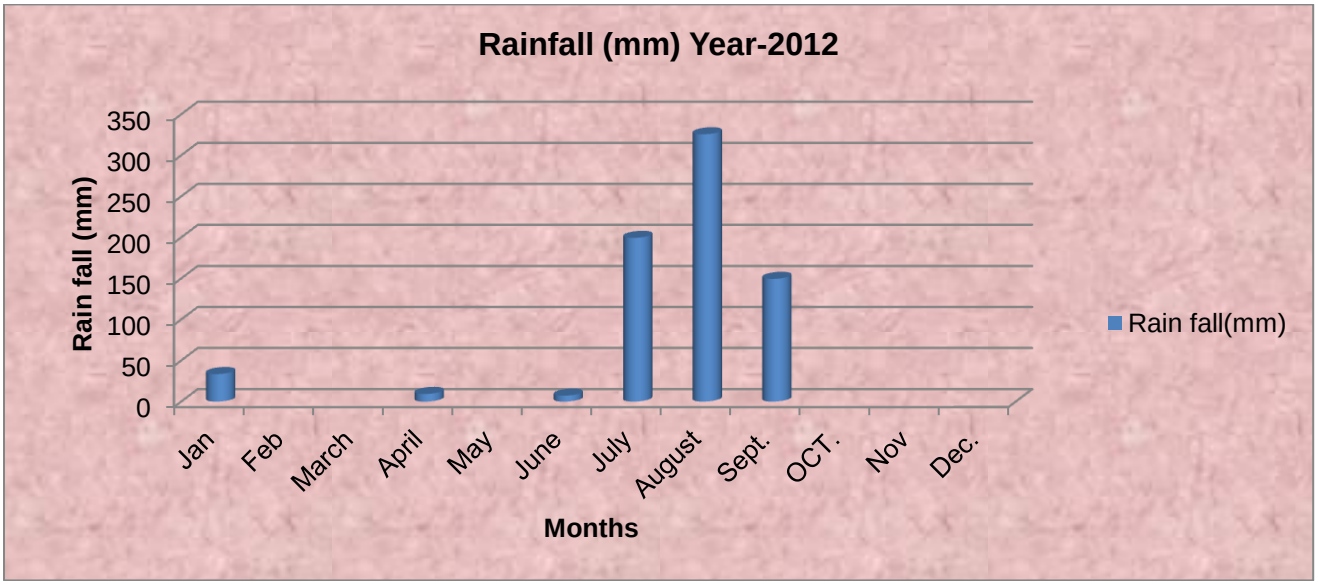

Fig 57: Monthly rainfall distribution

Temperature minimum and maximum: In the year 2012 the maximum temperature varied from 19.4 to 41.8 ^{o}c and minimum was ranged from 6.1 to 26.7 ^{o}c .

Relative humidity (%): The relative humidity in the year 2012 varied from 40.2 to 90.9 %.

Rain fall (mm): The total precipitation during kharif 2012 was recorded 679.7mm and in the crop growth period it was recorded 584.5mm.

Evaporation: The evaporation in the year 2012 ranged from 1.6 to 11.2 mm/day.

Water table: The water table position during the period from January 2012 to December 2012 is presented in table 58. It was variable in different months and varied from 14.1 to 17.4 m.

Table 59: Effect of different treatments on pearl millet crop

Treatment	Year 2013				
	Grain Yield (kg/ha)	Stover Yield (kg/ha)	Net Income (Rs/ha)	B:C Ratio	W U E (kg/ha-mm)
T1 Control	980	3094	454	1.03	1.60
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	2300	6338	20147	2.08	3.76
T3 Half of he recommended dose of fertilizer	1495	4217	7407	1.44	2.45
T4 50% N of the recommended dose to meet through farm residue	1528	4474	7190	1.40	2.50
T5 50% N of the recommended dose to meet through FYM	1605	5032	8851	1.49	2.63
T6 50% N through fertilizer + 50% N through farm residue	2398	6810	19334	1.98	3.92
T7 50% N through fertilizer + 50% N through FYM	2575	7075	21926	2.10	4.21
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	2490	6623	20604	2.07	4.08
T9 Farmers method (10-15 kg N^{-1})	1326	4376	6264	1.39	2.17
SEm ±	108	363	--	--	--
CD at 5%	314	1059	--	--	--
CV (%)	11.64	13.63	--	--	--
Actual Rainfall (mm) during the season	**987.4**	--	--	--	--
Rainfall (mm) during crop growth period	**610.8**	--	--	--	--

The data on seed yield of pearl millet presented in table 59 and fig 58 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 2575kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 4.21 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively**.**

The data on gross monitory return as influenced by organic and inorganic fertilizer sources under different treatments are given in table indicate that amongst the treatment T7 i.e. 50% N of RDF through FYM + 50% N meet through inorganic fertilizer had higher net return (of Rs. 21,926/- and BC ratio of 2.10 , while the lowest BC ratio was recorded in control treatment 1.03

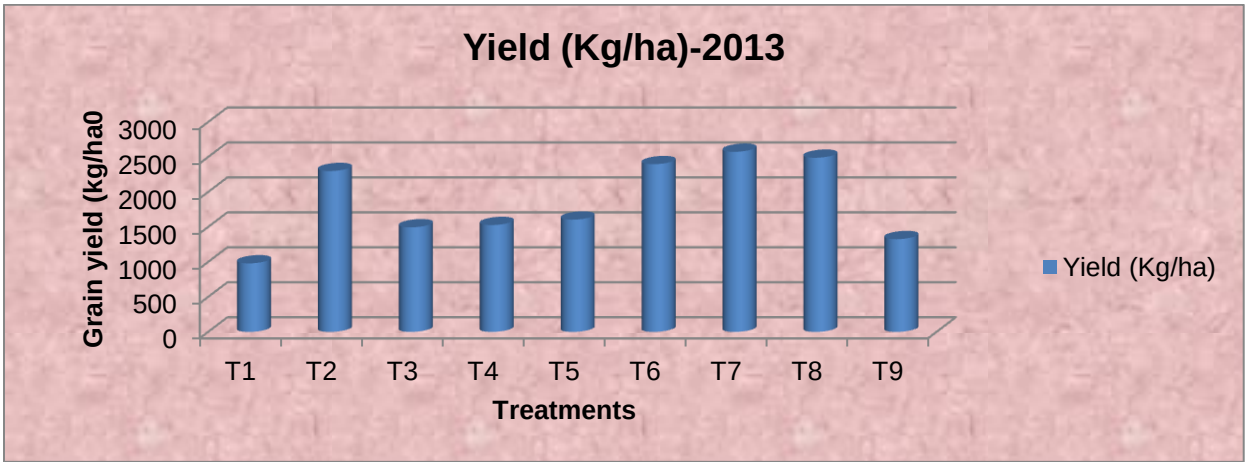

Fig 58: Pearl millet grain yield in different treatment

Table 60: Monthly meteorological observations recorded at R.B.S. College ,Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	21.5	5.9	86.4	12.9	1.4	17.7
February	24.4	10.8	89.2	39.	2.1	17.2
March	33.6	15.5	80.0	5.5	3.9	17.8
April	38.4	19.2	57.5	-	7..0	17.0
May	37.9	18.7	43.8	2.8	8.0	16.7
June	36.6	25.3	68.0	87.1	6.0	17.2
July	34.5	26.8	81.1	302.1	3.5	16.8
August	33.7	26.1	89.1	356.3	4.4	15.9
September	36.1	24.7	82.1	129.8	4.7	16.2
October	32.5	21.4	72.7	28.4	3.2	16.4
November	28.7	12.5	59.6	-	2.2	16.4
December	24.3	1.9	63.6	13.5	1.5	16.6

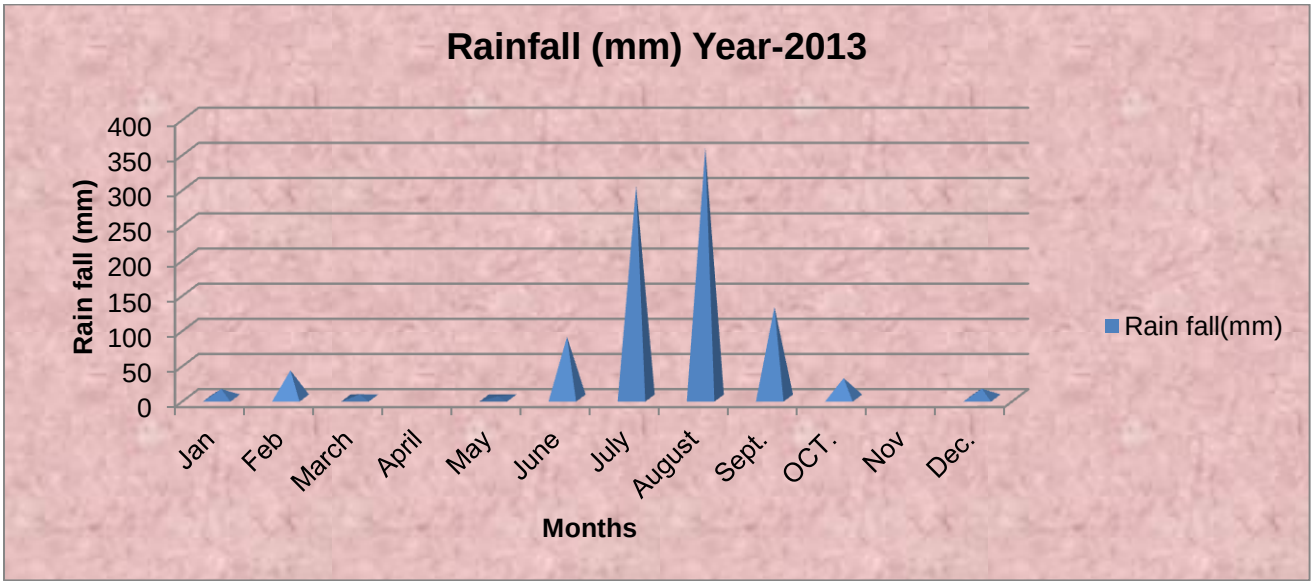

Fig 59: Monthly rain fall distribution

Temperature minimum and maximum: In the year 2013 the maximum temperature varied from 21.5 to 38.4 ^{o}c and minimum was ranged from 1.9 to 26.8 ^{o}c .

Relative humidity (%): The relative humidity in the year 2013 varied from 43.8 to 89.2 %.

Rain fall (mm): The total precipitation during kharif 2013 was recorded 987.4 mm and in the crop growth period it was recorded 610.8 mm.

Evaporation: The evaporation in the year 2013 ranged from 1.4 to 8.0 mm/day.

Water table: The water table position during the period from January 2013 to December 2013 is presented in table 60. It was variable in different months and varied from 15.9 to 17.8 m.

Table 61 : Effect of different treatments on pearl millet crop

Treatment	Year 2014				
	Grain Yield (kg/ha)	Stover Yield (kg/ha)	Net Income (Rs/ha)	B:C Ratio	W U E (kg/ha-mm)
T1 Control	890	2100	(-)1799	0.88	3.85
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	2825	5904	23,556	2.32	12.21
T3 Half of he recommended dose of fertilizer	1884	4220	11,495	1.69	8.14
T4 50% N of the recommended dose to meet through farm residue	1932	4444	11,900	1.70	8.35
T5 50% N of the recommended dose to meet through FYM	2005	4692	13,011	1.76	8.66
T6 50% N through fertilizer + 50% N through farm residue	3015	6452	26,049	2.42	13.03
T7 50% N through fertilizer + 50% N through FYM	3103	6702	27,337	2.48	13.41
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	3065	6498	25,552	2.31	13.24
T9 Farmers method (10-15 kg N^{-1})	1408	3407	5,951	1.39	6.08
SEm ±	134	356	-	-	-
CD at 5%	390	1037	-	-	-
CV (%)	11.98	14.41	-	-	-
Actual Rainfall (mm) during the season	**368.3**	---	-	-	-
Rainfall (mm) during crop growth period	**231.4**	---	-	-	-

The data on seed yield of pearl millet presented in table 61and fig 60 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 3103 kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 13.41 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively**.**

The data on gross monitory return as influenced by organic and inorganic fertilizer sources under different treatments are given in table indicate that amongst the treatment T7 i.e. 50% N of RDF through FYM + 50% N meet through inorganic fertilizer had higher net return (of Rs. 25,552/- and BC ratio of 2.31, while the lowest BC ratio was recorded in control treatment 0.88

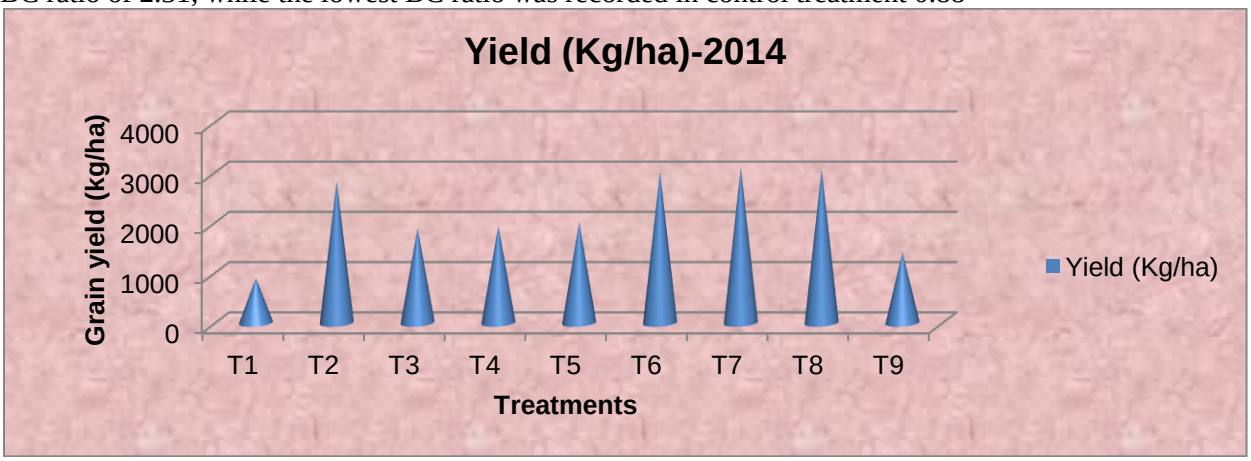

Fig 60: Pearl millet grain yield in different treatments

Table 62: Monthly meteorological observations recorded at R.B.S. College ,Bichpuri, Agra

Months	Temperature (0^C)		Relative humidity(%)	Rainfall (mm)	Evaporation (mm/day)	Water table (m)
	Max.	Min.				
January	18.2	8.2	81.7	46.3	1.9	16.6
February	23.0	10.6	71.0	50.8	1.8	16.5
March	31.2	15.1	55.3	14.2	3.7	16.5
April	37.2	19.3	53.6	-	7.0	16.8
May	41.3	24.9	53.2	-	8.2	16.9
June	42.3	28.6	63.1	32.2	8.6	16.8
July	37.1	27.5	67.2	98.6	8.2	15.9
August	34.9	26.2	85.9	124.7	8.0	16.1
September	35.2	24.4	73.5	81.9	7.9	16.0
October	34.5	19.8	68.7	4.8	4.0	16.1
November	30.1	13.1	80.9	-	4.0	16.0
December	22.3	7.6	55.8	4.8	4.5	16.2

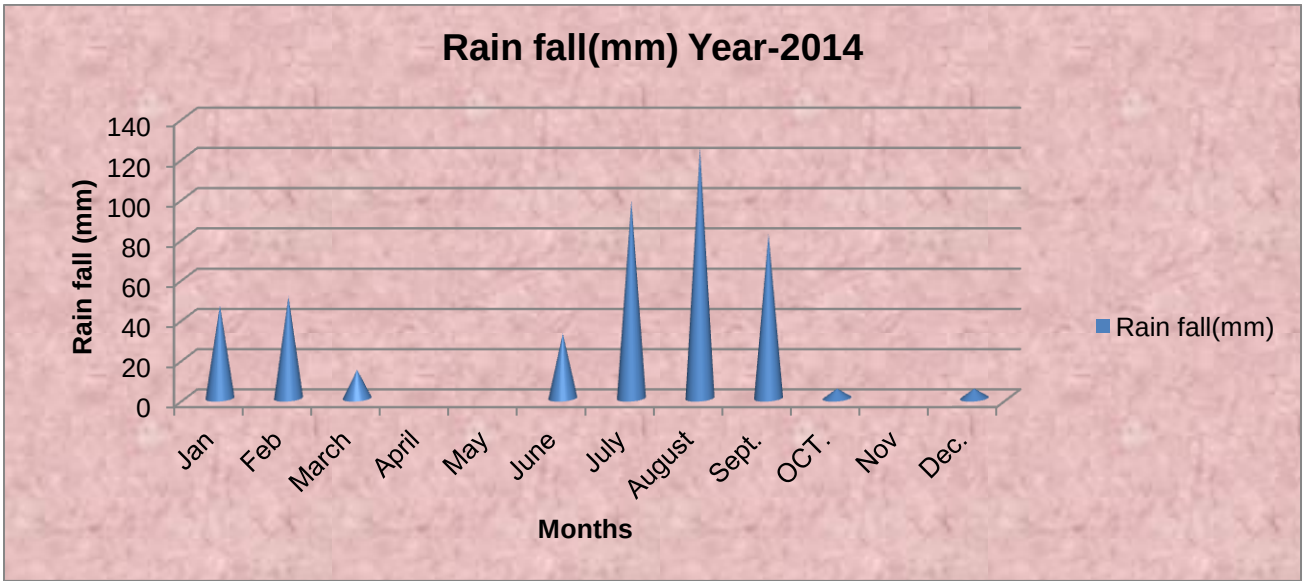

Fig 61: Monthly rain fall distribution

Temperature minimum and maximum: In the year 2014 the maximum temperature varied from 18.2 to 42.3 ^{o}c and minimum was ranged from 7.6 to 28.6 ^{o}c .

Relative humidity (%): The relative humidity in the year 2014 varied from 53.2 to 85.9 %.

Rain fall (mm): The total precipitation during kharif 2014 was recorded 368.3 mm and in the crop growth period it was recorded 231.4 mm.

Evaporation: The evaporation in the year 2014 ranged from 1.8 to 8.6 mm/day.

Water table: The water table position during the period from January 2014 to December 2014 is presented in table 62. It was variable in different months and varied from 15.9 to 16.9 m.

Table 63 : Effect of different treatments on pearl millet crop

Treatment	Year 2015				
	Grain Yield (kg/ha)	Stover Yield (kg/ha)	Net Income (Rs/ha)	B:C Ratio	RWUE (kg/ha/mm)
T1 Control	--	1628	(-)10998	0.22	--
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	--	4025	(-)7923	0.43	--
T3 Half of he recommended dose of fertilizer	--	2786	(-)8421	0.33	--
T4 50% N of the recommended dose to meet through farm residue	--	2815	(-)8818	0.32	--
T5 50% N of the recommended dose to meet through FYM	--	2905	(-)8783	0.33	--
T6 50% N through fertilizer + 50% N through farm residue	--	4076	(-)8286	0.42	--
T7 50% N through fertilizer + 50% N through FYM	--	4167	(-)8250	0.43	--
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	--	4042	(-)8522	0.41	--
T9 Farmers method (10-15 kg N^{-1})	--	1975	(-)8463	0.26	--
SEm ±	--	93.2	--	--	--
CD at 5%	--	--	--	--	--
CV (%)	--	--	--	--	--
Actual Rainfall (mm) during the season	**233.2**	--	--	--	--
Rainfall (mm) during crop growth period	**93.2**	--	--	--	--

The data on seed yield of pearl millet presented in table 63 and fig 62 clearly indicated that stover yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 4167 kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer.

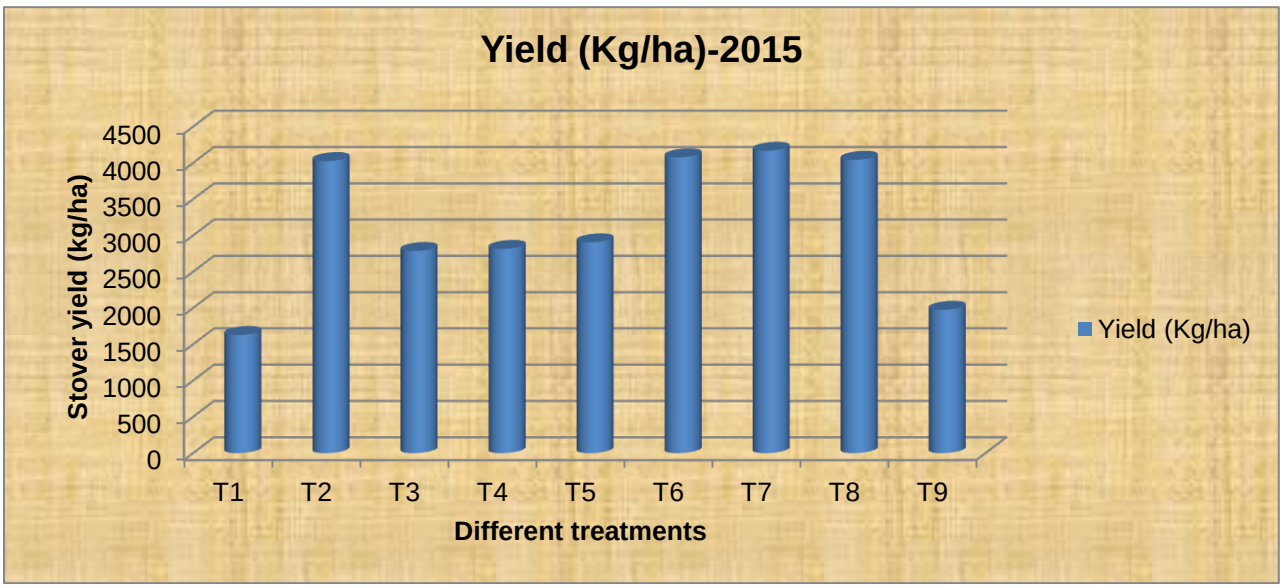

Fig 62: Pearl millet grain yield in different treatments

Table 64: Monthly meteorological observations recorded at R.B.S. College ,Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	16.8	8.2	73.3	42.6	5.2	16.2
February	25.7	11.1	87.2	1.1	5.8	16.3
March	28.9	15.4	87.8	121.9	6.0	16.3
April	36.1	19.8	75.9	36.2	6.1	16.4
May	42.2	25.3	73.6	138.3	6.0	15.9
June	41.5	26.8	68.8	46.9	6.0	15.9
July	37.1	27.5	67.2	57.9	6.2	15.6
August	34.9	26.2	85.8	129.7	6.2	15.6
September	37.3	24.8	66.9	17.0	5.8	15.3
October	36.4	20.5	77.2	17.7	5.5	15.4
November	29.1	15.7	84.5	-	5.5	15.5
December	23.2	7.7	89.9	-	5.4	15.5

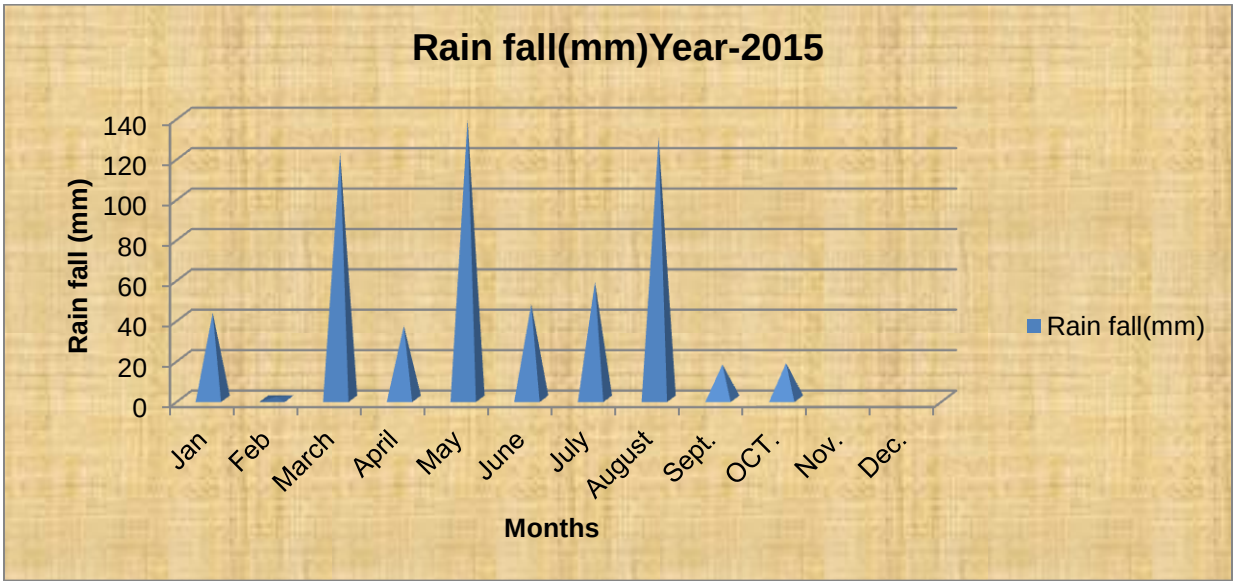

Fig 63: Monthly rain fall distribution

Temperature minimum and maximum: In the year 2015 the maximum temperature varied from 16.8 to 42.2 ^{o}c and minimum was ranged from 7.7 to 27.5 ^{o}c .

Relative humidity (%): The relative humidity in the year 2015 varied from 66.9 to 89.9 %.

Rain fall (mm): The total precipitation during kharif 2015 was recorded 233.2 mm and in the crop growth period it was recorded 93.2 mm.

Evaporation: The evaporation in the year 2015 ranged from 5.2 to 6.2 mm/day.

Water table: The water table position during the period from January 2015 to December 2015 is presented in table 64. It was variable in different months and varied from 15.3 to 16.4 m.

Table 65 : Effect of different treatments on pearl millet crop

Treatment	Year 2016				
	Grain Yield (kg/ha)	Stover Yield (kg/ha)	Net Income (Rs/ha)	B:C Ratio	W U E (kg/ha-mm)
T1 Control	1449	5216	13420	1.85	3.86
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	3040	10048	41288	3.22	8.10
T3 Half of he recommended dose of fertilizer	2289	7554	27894	2.62	6.10
T4 50% N of the recommended dose to meet through farm residue	2320	7795	28635	2.66	6.21
T5 50% N of the recommended dose to meet through FYM	2409	7998	30153	2.73	6.42
T6 50% N through fertilizer + 50% N through farm residue	3150	10400	43062	3.27	8.39
T7 50% N through fertilizer + 50% N through FYM	3568	11596	50932	3.67	9.51
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	2016	10494	46378	3.29	9.19
T9 Farmers method (10-15 kg N^{-1})	2632	7157	23302	2.36	5.37
SEm ±	181	679	--	--	--
CD at 5%	527	1978	--	--	--
CV (%)	13.73	15.62	--	--	--
Actual Rainfall (mm) during the season	**991.2**	--	--	--	--
Rainfall (mm) during crop growth period	**375.3**	--	--	--	--

The data on seed yield of pearl millet presented in table 65 and fig 64 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 3568 kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 9.51 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively.

The data on gross monitory return as influenced by organic and inorganic fertilizer sources under different treatments are given in table indicate that amongst the treatment T7 i.e. 50% N of RDF through FYM + 50% N meet through inorganic fertilizer had higher net return (of Rs. 50,932/- and BC ratio of 3.67, while the lowest BC ratio was recorded in control treatment

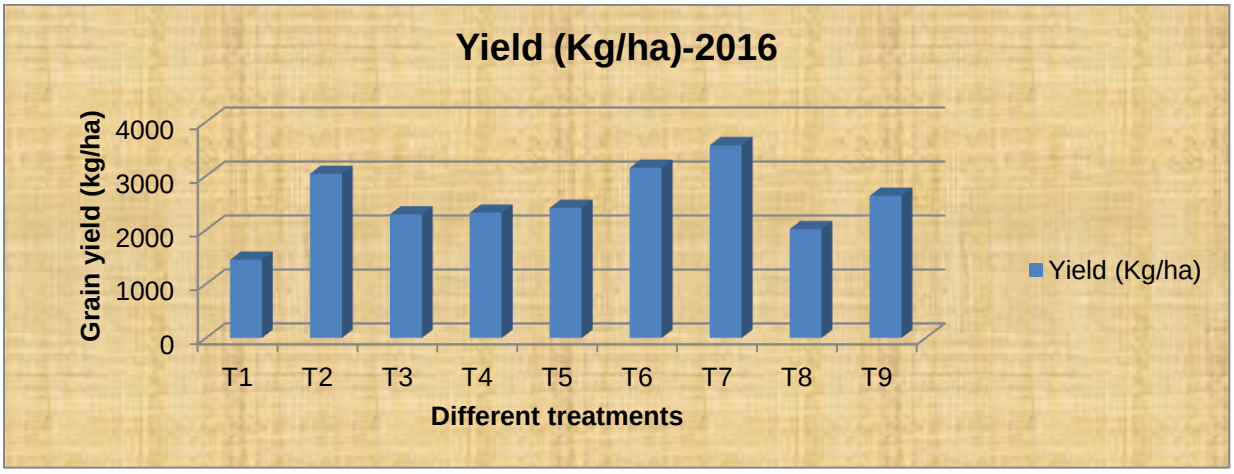

Fig 64: Pearl millet grain yield in different treatments

Table 66: Monthly meteorological observations recorded at R.B.S. College ,Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	22.4	8.7	94.9	9.9	2.1	15.8
February	27.2	11.6	86.4	-	2.2	15.6
March	33.5	17.7	75.6	-	2.8	15.6
April	40.1	22.8	75.3	-	5.3	15.9
May	41.5	26.6	67.6	40.0	7.3	15.3
June	40.3	28.8	78.0	62.9	7.6	15.5
July	37.1	27.5	67.2	634.9	6.2	15.6
August	32.8	26.3	93.8	175.3	6.0	15.4
September	34.7	25.4	87.6	27.8	5.7	16.5
October	34.5	19.6	90.6	7.0	5.4	16.9
November	29.5	11.5	86.6	-	5.6	17.7
December	23.5	8.9	87.1	-	5.6	17.8

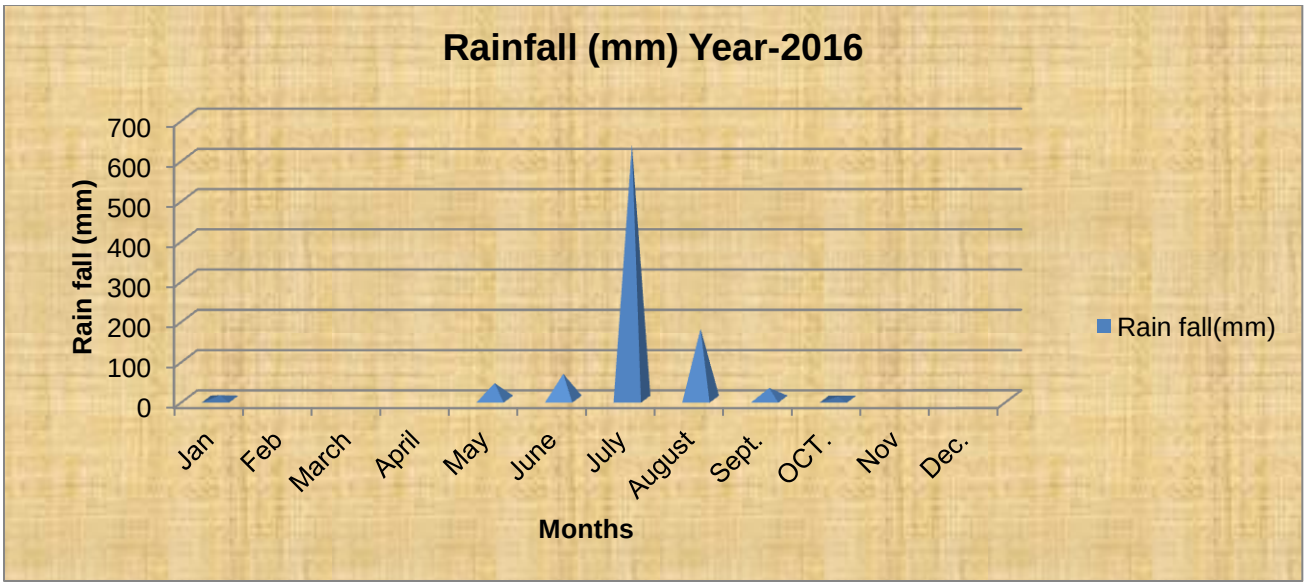

Fig 65: Monthly rainfall distribution

Temperature minimum and maximum: In the year 2016 the maximum temperature varied from 22.4 to 41.5 ^{o}c and minimum was ranged from 8.7 to 28.8 ^{o}c .

Relative humidity (%): The relative humidity in the year 2016 varied from 67.2 to 94.9 %.

Rain fall (mm): The total precipitation during kharif 2016 was recorded 991.2 mm and in the crop growth period it was recorded 375.3 mm.

Evaporation: The evaporation in the year 2016 ranged from 2.1 to 7.6 mm/day.

Water table: The water table position during the period from January 2016 to December 2016 is presented in table 66. It was variable in different months and varied from 15.3 to 17.8 m.

Table 67 : Effect of different treatments on pearl millet crop

Treatment	Year 2017				
	Grain Yield (kg/ha)	Stover Yield (kg/ha)	Net Income (Rs/ha)	B:C Ratio	W U E (kg/ha-mm)
T1 Control	452	1546	(-)4484	0.66	2.76
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	970	3193	2863	1.18	5.91
T3 Half of he recommended dose of fertilizer	672	1995	(-)1928	0.87	4.10
T4 50% N of the recommended dose to meet through farm residue	710	2343	(-)1412	0.91	4.33
T5 50% N of the recommended dose to meet through FYM	726	2403	(-)1194	0.92	4.43
T6 50% N through fertilizer + 50% N through farm residue	1136	3612	4057	1.23	6.93
T7 50% N through fertilizer + 50% N through FYM	1200	3864	5247	1.30	7.32
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	1094	3413	3310	1.19	6.67
T9 Farmers method (10-15 kg N^{-1})	656	2184	(-)751	0.94	4.00
SEm ±	62	226	--	--	---
CD at 5%	208	756	--	--	---
CV (%)	13.11	16.60	--	--	---
Actual Rainfall (mm) during the season	**246,3**	---	--	--	---
Rainfall (mm) during crop growth period	**164.0**	---	---	---	---

The data on seed yield of pearl millet presented in table 67 and fig 66 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 1200 kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 7.32 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively**.**

The data on gross monitory return as influenced by organic and inorganic fertilizer sources under different treatments are given in table indicate that amongst the treatment T7 i.e. 50% N of RDF through FYM + 50% N meet through inorganic fertilizer had higher net return (of Rs. 5247/- and BC ratio of 1.30, while the lowest BC ratio was recorded in control treatment 0.66

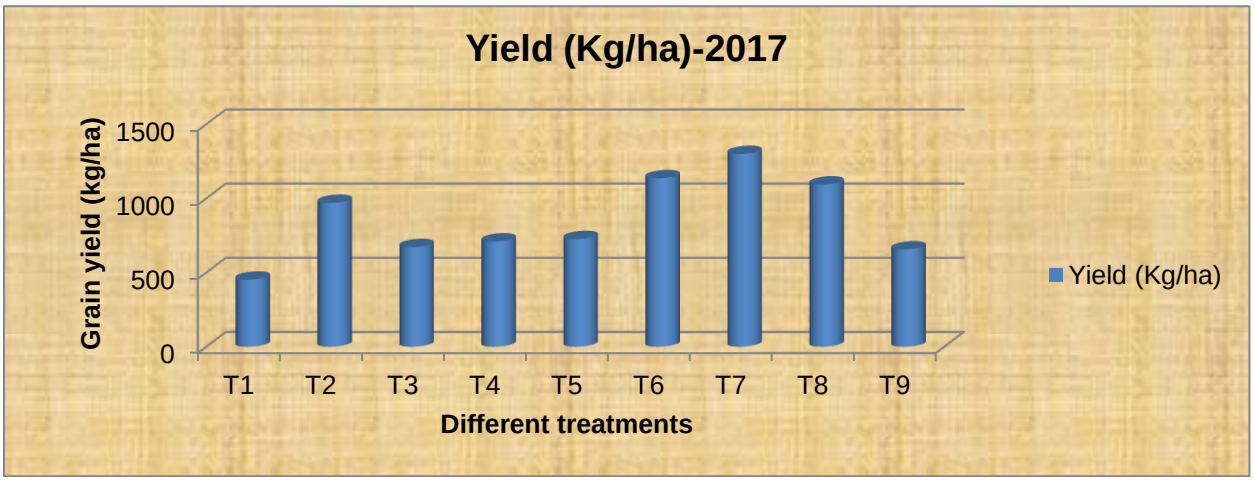

Fig 66: Pearl millet grain yield in different treatments

Table 68: Monthly meteorological observations recorded at R.B.S. College, Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	21.0	7.6	94.9	26.5	5.3	18.2
February	26.7	10.3	84.9	-	5.4	18.2
March	31.6	14.9	71.7	21.8	6.1	18.5
April	40.6	21.8	53.1	-	6.2	18.6
May	39.9	26.2	65.9	51.2	6.1	18.5
June	39.1	27.7	80.4	42.8	6.2	18.6
July	35.8	27.3	90.3	31.3	4.3	18.6
August	34.3	26.4	94.0	128.0	3.2	18.7
September	36.3	25.3	91.6	16.0	3.4	18.7
October	37.3	19.9	82.1	-	4.2	18.7
November	28.8	12.9	88.5	-	1.9	19.1
December	23.7	9.3	94.1	2.1	1.3	19.9

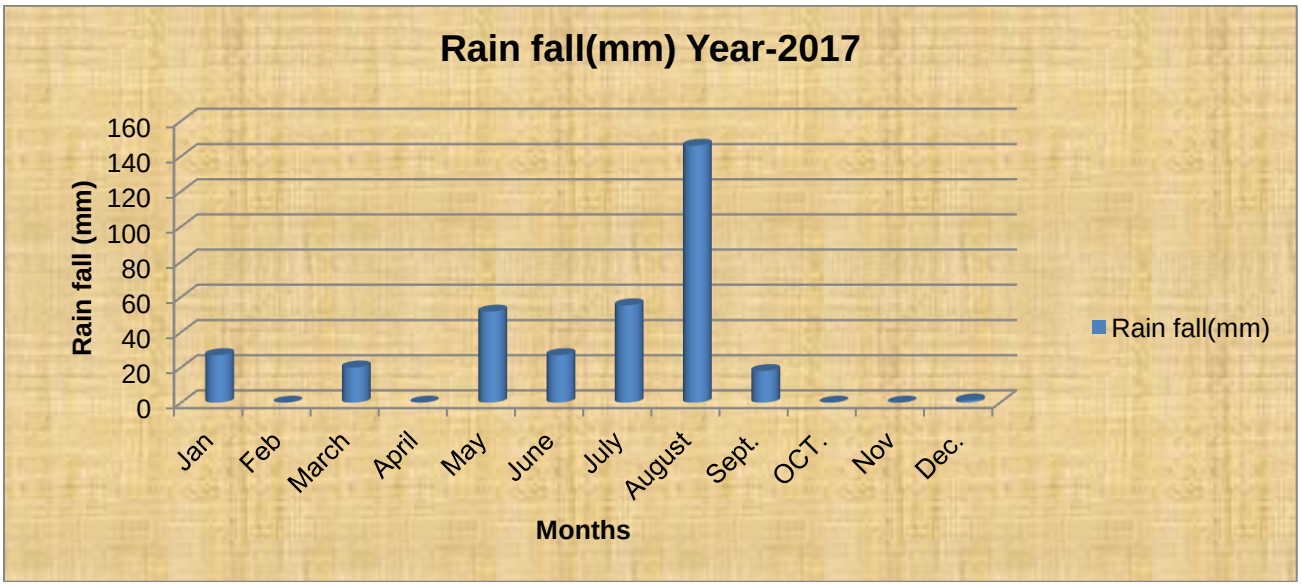

Fig 67: Monthly rain fall distribution

Temperature minimum and maximum: In the year 2017 the maximum temperature varied from 21.0 to 40.6 ^{o}c and minimum was ranged from 7.6 to 27.7 ^{o}c .

Relative humidity (%): The relative humidity in the year 2017 varied from 53.1 to 94.9 %.

Rain fall (mm): The total precipitation during kharif 2017 was recorded 246.3 mm and in the crop growth period it was recorded 164.0 mm.

Evaporation: The evaporation in the year 2017 ranged from 1.3 to 6.2 mm/day.

Water table: The water table position during the period from January 2017 to December 2017 is presented in table 68. It was variable in different months and varied from 18.2 to 19.9 m.

Table 69 : Effect of different treatments on pearl millet crop

Treatment	Year 2018				
	Grain Yield (kg/ha)	Stover Yield (kg/ha)	Net Income (Rs/ha)	B:C Ratio	RW U E (kg/ha-mm)
T1 Control	1378	22.04	13,025	1.81	1.71
T2 Recommended dose of fertilizer (60 kg N + 40 kg P2O5/ha)	2746	5382	43,432	3.39	3.42
T3 Half of he recommended dose of fertilizer	2005	3412	27,130	2.59	2.49
T4 50% N of the recommended dose to meet through farm residue	2210	3867	31,113	2.75	2.75
T5 50% N of the recommended dose to meet through FYM	2365	4077	32,401	2.81	2.82
T6 50% N through fertilizer + 50% N through farm residue	2946	5852	47,400	3.51	3.66
T7 50% N through fertilizer + 50% N through FYM	3075	6532	50,775	3.67	3.82
T8 Recommended dose of fertilizer Zinc as soil application (25 kg $ZnSO4^{-1}$)	2990	6318	47,744	3.38	3.72
T9 Farmers method (10-15 kg N^{-1})	1720	2605	21,335	2.32	2.15
SEm ±	130	269	-	-	-
CD at 5%	380	785	-	-	-
CV (%)	11.02	12.00	-	-	-
Actual Rainfall (mm) during the season	**931.8**	--	-	-	-
Rainfall (mm) during crop growth period	**804.8**	--	-	-	-

The data on seed yield of pearl millet presented in table 69 and fig 68 clearly indicated that seed yield of pearl millet significantly influenced by various fertilizer option. However, maximum seed yield of 3075 kg/ha was registered under those treatment which receiving 50 per cent of N of RDF through FYM along with rest 50 per cent N applied through inorganic fertilizer (T7) which was significantly superior over the yield recorded with control, farmers method and half N of RDF, either through farm residue, FYM and inorganic fertilizer. It was also observed that application of RDF applied with inorganic fertilizer (T2 & T8) or 50 per cent N through farm residue in conjunction with 50 per cent N meet through fertilizer were also produced significantly more yield over the yield obtained under control, 50 per cent N meet out through organic sources or by inorganic fertilizer. Similar trends were also noticed with regard to rain water use efficiency. Highest rain water use efficiency of 3.83 kg/ha/mm was recorded when RDF applied through FYM and inorganic fertilizer both in 50 : 50 ratio respectively**.**

The data on gross monitory return as influenced by organic and inorganic fertilizer sources under different treatments are given in table indicate that amongst the treatment T7 i.e. 50% N of RDF through FYM + 50% N meet through inorganic fertilizer had higher net return (of Rs. 50,775/- and BC ratio of 3.67, while the lowest BC ratio was recorded in control treatment 1.81

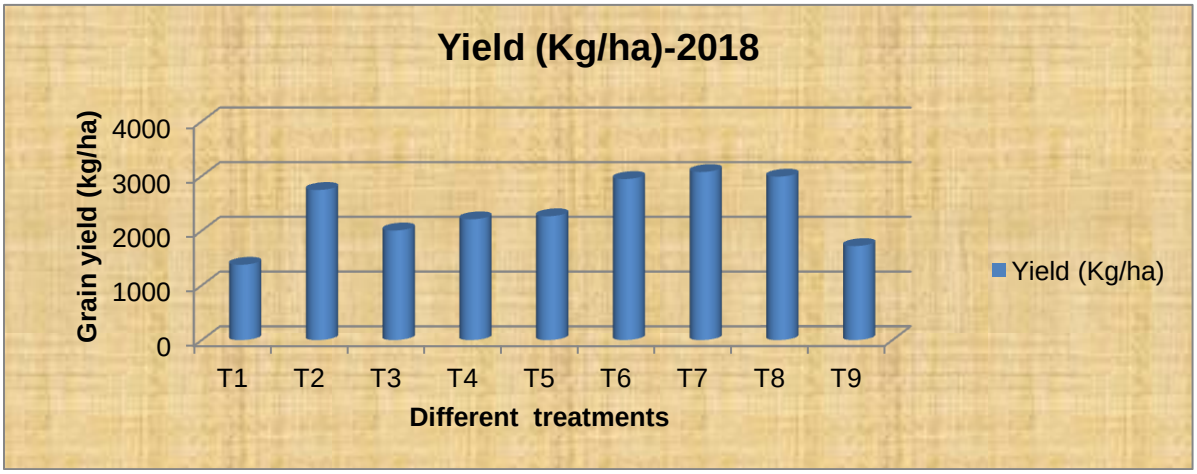

Fig 68: Pearl millet grain yield in different treatments

Table 70: Monthly meteorological observations recorded at R.B.S. College, Bichpuri, Agra

Months	Temperature (0^C) Max.	Min.	Relative humidity(%)	Rain fall(mm)	Evaporation (mm/day)	Water table (m)
January	21.6	6.3	76.8	-	1.1	19.3
February	27.0	11.4	77.4	-	2.2	19.3
March	34.2	15.6	70.6	-	4.1	19.8
April	38.4	22.6	58.7	127.0	6.0	20.3
May	41.9	26.2	61.2	51.0	6.9	20.3
June	40.7	29.2	68.0	100.0	7.4	20.4
July	34.7	27.2	88.3	533.0	3.6	20.6
August	33.4	26.0	91.0	200.0	3.0	20.7
September	33.3	24.4	87.3	98.0	2.8	20.7
October	34.6	19.4	69.4	5.0	3.8	20.7
November	29.6	13.2	69.0	--	2.0	20.8
December	23.1	6.1	79.1	--	1.1	20.8

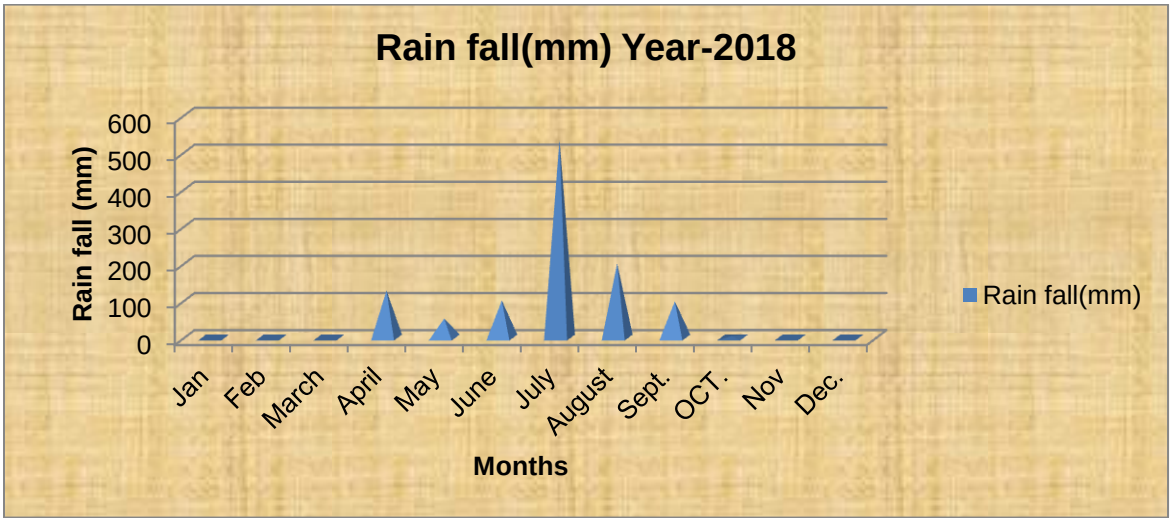

Fig 69: Monthly rainfall distribution

Temperature minimum and maximum: In the year 2018 the maximum temperature varied from 21.6 to 41.9 ^{o}c and minimum was ranged from 6.1 to 29.2^{o}c .

Relative humidity (%): The relative humidity in the year 2018 varied from 72.4 to 84.5 %.

Rain fall (mm): The total precipitation during kharif 2017 was recorded 931.8 mm and in the crop growth period it was recorded 804.8 mm.

Evaporation: The evaporation in the year 2018 ranged from 1.1 to 7.4 mm/day.

Water table: The water table position during the period from January 2018 to December 2018 is presented in table 70. It was variable in different months and varied from 19.3 to 20.8 m.

Conclusion:

Under dry land condition the best dose of fertilizer was recorded in T7 (50%N by fertilizer + 50% N by FYM) with maximum yield of pearl millet and it was significant among all other fertilizer doses except T8 (RDF+25kg $Znso_4$) , T6 50% N by fertilizer + 50% N by farm residue) & T2 (Recommended dose of fertilizer). Whereas the lowest yield was in control (no fertilizer application in 34 years experimentation) and T9 farmers method . The doses T3 half of recommended dose of fertilizer, T4 50% N of the recommended dose to meet through farm residue& T5 50% N of recommended dose to meet through FYM were recorded at par in all the years of experimentation, Actual rain fall in the season during all the years of the experimentation was good and this was more as received during crop growth period. It is very interestingly that water use efficiency, net profit and B:C ratio were also higher in high yielding doses (treatments) and lower in other doses.

Recommendations:

1. Farmers should use 50% N as inorganic fertilizer and 50% N as FYM on priority basis.
2. If the FYM is not available then farmers should apply RDF + 25 kg Zinc per hectare.
3. 50% N as inorganic fertilizer and 50% N as farm residue mode should be adopted by the farmers in these conditions.
4. In kharif pearl millet, farmers generally uses low amount of fertilizer, if the farmers use full amount of RDF in dry land conditions also may get high yield and net profit.

Control (No Fertilizer)

R D F (60kgN+40kg P_2O_5/ha)

50% N through inorganic fertilizer

50% N through farm residue

50% N through F Y M

50% N through inorganic fertilizer + 50% N through farm residue

50% N through inorganic fertilizer + 50% N through F Y M

R D F (60kgN+40kg P_2O_5/ha) +

Farmers method(10-15