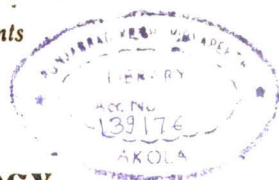


**COMPARATIVE STUDY OF DIFFERENT IRRIGATION
METHODS FOR SUMMER GROUNDNUT**

THESIS

*Submitted to the
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola
in partial fulfilment of the requirements
for the Degree of*



**MASTER OF TECHNOLOGY
IN
AGRICULTURAL ENGINEERING
(IRRIGATION AND DRAINAGE ENGINEERING)**

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INDIA**

DECLARATION OF STUDENT

I hereby declare that the research work and its interpretation of the thesis entitled, "COMPARATIVE STUDY OF DIFFERENT IRRIGATION METHODS FOR SUMMER GROUNDNUT" or part there of has not been submitted for any other degree or diploma of any university; nor the data have been derived from any thesis/publication of any university or scientific organization. The sources of materials used and all assistance received during the course of investigation have been duly acknowledged.

Place : Akola


Date : 30.06.2020


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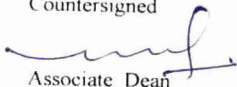
CERTIFICATE

This is to certify that the thesis entitled, "COMPARATIVE STUDY OF DIFFERENT IRRIGATION METHODS FOR SUMMER GROUNDNUT," Submitted in partial fulfillment of the requirements for the degree of Master of Technology in Agricultural Engineering (Irrigation and Drainage Engineering) of the Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, is record of bonafide research work carried out by Shri. Prashant Ajabrao Gawande under my guidance and supervision. The subject of the thesis has been approved by the student's advisory committee.


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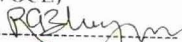
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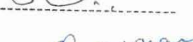
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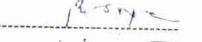
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(Prashant A. Gawande)

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LIST OF ABBREVIATIONS

| ABBREVIATIONS | FULL FORM /MEANING |
|--------------------|---|
| α | Alpha |
| @ | At the rate of |
| $^{\circ}\text{C}$ | Degree Centigrade |
| Abst. | Abstract |
| A.H | At harvest |
| Agric. | Agriculture |
| Amer. | American |
| ASAE | American society of Agricultural Engineers |
| ASCE | American society of Civil Engineers |
| APAU | Andhra Pradesh Agricultural University |
| BBF | Broad bed furrow |
| B/C | Benefit Cost Ratio |
| C.D. | Critical difference |
| CV. | Crop variety |
| cm | Centimeter |
| contd. | Continued |
| Conf. | Conference |
| Cong. | Congress |
| CPE | Cumulative pan evaporations |
| d Σ m | Desi simon per meter |
| E.C | Electrical conductivity |
| <i>et al.</i> , | <i>et alibi</i> (and others) |
| Etc | Crop evapotranspiration |
| Epan | Pan evaporation |
| FPE | Fractions of pan evaporation |
| fig | Figure |
| g. or gm | Grams |
| G.T.O. | Gravenite take-off |
| HP | Horse power |
| ha | Hectare |
| hrs | Hours |
| IARI | Indian Agricultural Research Institute |
| IDE | Irrigation and drainage engineering |
| ICRISAT | International Crop Research Institute for semi arid tropics |
| Int. | International |

| | |
|-------------------------------|--|
| IW | Irrigation water |
| J | Journal |
| Kc | Crop coefficient |
| kg | Killogram |
| kp | Pan coefficient |
| LDPE | Low density polyethylene |
| lit/plot | Litres per plot |
| lph | Litres per hours |
| MPAU | Mahatma Phule Agricultural University |
| m | meters |
| meq/l | Milli equivalent per litres |
| ml | Milli litres |
| M.T. | Metric tonnes |
| N | Nitrogen |
| NS | Non significant |
| no | Number |
| Dr. PDKV | Dr.Panjabrao Deshmukh Krishi Vidyapeeth Akola |
| Proc. | Proceedings |
| PVC | Poly vinyl Chloride |
| % | Per cent |
| P ₂ O ₅ | Phosphorous |
| q/ha | Quintals per hectare |
| Res. | Research |
| RH | Relative Humidity |
| Rs | Rupees |
| Sig | Significant |
| SAR | Sodium absorption ratio |
| soc | Society |
| SWD | Soil water depletion |
| Trans. | Transactions |
| TAG24 | Trombey Akola groundnut – 24 |
| Univ. | University |
| USWB | United states weather bureau |
| UC | Uniformity coefficient |
| Viz. | Namely |
| WUE | Water use efficiency |
| WEE | Water expense efficiency. |

CHAPTER I

INTRODUCTION

Soil and water are going to be most crucial basic resources in crop production due to diverse demands. In Maharashtra, according to Barwe Committee, only 13 per cent cultivated land is under irrigation and can be maximised upto 26 per cent. So only way to increase percentage is by adoption of modern water saving irrigation technique like microirrigation. Recently groundnut is being extensively grown during summer for stable and higher yield (2800-3750 kg/ha). However, during mid summer the atmospheric evaporative demand is very high, thereby the water requirement of crop is also very high. To increase irrigation potential to some extent it is necessary to use water judiciously for agricultural production by developing advanced and efficient systems of microirrigation.

Microirrigation is a convenient and efficient means of supplying water directly to the soil surrounding individual plants in sufficient quantities to meet the demands imposed by evapotranspiration, thereby minimising deep percolation and evaporation losses. Microirrigation system offers special agronomical, agrotechnical and economic advantages for efficient use of water and labour. In this system, the extensive network of pipes with outlets as emitters are provided at predetermined spacing through which the monitored quantity of water is allowed to drip at the rate of few litres per hour just to meet the crop demand. The system applies water slowly to keep soil moisture within desired range for plant growth. As a result, water economy has been observed to the extent of 60 to 70 per cent compared to traditional systems of surface irrigation. In microsprinkler systems water is applied daily on complete surface area of soil in the form of spray through pipe network.

It is kind of an artificial rain and gives good results with water saving. The perfect design of drip and microsprinkler irrigation requires the knowledge of moisture distribution pattern. The design of drip irrigation system mainly involves the determination of lateral and emitter spacing which is a function of wetted area of

crop root zone. Water moves through soil profile under gravitational and capillary forces. It horizontally, wets only a part of potential soil root zone. The moisture distribution resulted from isolated point sources wets the soil bulb axially symmetrical rather than in one dimensional fashion.

The BBF planting means the broad bed furrow planting in which the base furrow is significantly larger than ordinary furrow. The wide spaced furrow could be used on medium to fine textured soils. The broad bed furrow is successfully adopted for moisture conservation and drainage of excess water in rainy seasons for many crops. The research works proved that the BBF maintain good aeration, high moisture content and loose and uncompacted soil status with uniform distribution of water through the field.

Growth and yield of summer groundnut are greatly influenced by soil moisture, nutrients, environmental conditions and management practices. Absence of relevant information on these aspects, adversely affect the productivity of crop. The summer groundnut cultivation is require to be irrigated throughout the season to ensure adequate moisture specially at critical growth of the crop namely, flowering, peg formation and at pod formation stages and to save the crop from hazard of under watering and over watering throughout growth period of the crop for obtaining maximum production.

In order to generate technical information in respect of summer groundnut crop for farmers in respect of application of optimum water through different irrigation systems for getting maximum return per unit of natural resources, the field experiment was conducted at Department of Irrigation and Drainage Engineering, Dr. Panjabrao Deshmukh Krishi Vidhyapeeth, Akola, during 1999-2000 with the following specific objectives –

- 1) To compare the soil moisture status and salt distribution in the soil profile for drip, microsprinkler, drip inline and BBF system of irrigation.
- 2) To study the effect of irrigation system on growth, yield and quality of crop.
- 3) To compare the water requirement of the groundnut crop under different systems of irrigation.
- 4) To work out economics of drip, microsprinkler, drip inline and BBF system of irrigation.

CHAPTER II

REVIEW OF LITERATURE

The main focus of present study was to compare different irrigation systems from growth, crop yield and quality, water saving, water use efficiency point of view for summer groundnut Cv. TAG-24. The productivity per unit area per unit time depends upon judicious water management. When and how much to irrigate and what irrigation system to be used are still the problems at farmers level though the considerable research has been done

Although groundnut (*Arachis hypogaea L.*) is an important oilseed crop, very meager research work appears to have been done to develop technology in respect of planting techniques and different irrigation systems in India. The available literature on these aspects of groundnut cultivation in particular and other crops in general are summarised in this chapter.

Proper irrigation schedule based on precise crop water requirements at different stages of crop growth with desired quantity of water is required for optimum yields. The review of the comparative studies of different irrigation system on soil type, management practices for growth, yield and quality of crops carried out by various investigators are presented in this chapter under following heads.

1. Use and scope of different irrigation systems.
2. Irrigation scheduling
3. Design and arrangement.
4. Spacing and time of sowing or Dibbling
5. Water requirement and saving.
6. Soil type.
7. Irrigation efficiencies.
8. Soil moisture and salt distribution pattern.
9. Growth, yield and quality of summer groundnut.
10. Cost economics.

2.1 Use and Scope of different irrigation systems.

Following reviews are related to applicability of different irrigation systems.

Bresler (1977) stated that the system of drip irrigation is more advantageous for improving soil water regime to obtain more crop yield, minimizing salinity hazard to plants and restricting water supply to those parts of the field where the root system is more efficient.

Paliwal (1986) reported that drip, furrow and sprinkler systems are equally good at low water salinity for moderately salt tolerant crops. However, at higher water salinity drip is better than furrow followed by sprinkler. As foliar injury by sprinkler multiplies the adverse effects of salinity on crop growth.

Boman (1989) observed that the coefficient of variance (Cv) of two types of microsprinkler tested was found to be excellent (less than 2 per cent). Discharge rate of microsprinkler was found to be affected by diameter of spaghetti tubing. Discharge increase with increase in diameter.

Gutal *et al.* (1989^a) reported that 15 per cent increase in yield of groundnut and 24 per cent water saving was observed in microsprinkler irrigation over border irrigation.

Evans and Probsting (1990) stated that in drip irrigation, adequate water was available without deep percolation to orchards crop when irrigated at 100 per cent evapotranspiration.

Jaspal Singh *et al.* (1990) reported that microsprinkler is a low volume sprinkler that operates at low pressure. It is in between sprinkler and modern trickle system. It requires less energy than conventional sprinkler and is less susceptible to clogging than drip emitters. It has much larger area of coverage than drip emitter but much lower than conventional sprinkler. The microsprinkler covers the diameter of irrigation in between 3-6m with pressure ranging from 1 to 2 kg / cm².

Firake *et al.* (1992) concluded that increase in pressure of system increased the discharge of microsprinklers, increase in pressure increased vertical

movement of water and effective wetted area of the soil should only be considered for calculation of uniformity coefficient of micro-sprinkler. In fact, this should have been related with the increase in volume of water which increases with the operating pressure. It also revealed that downward vertical movement of water in the soil increases with increase in operating pressure.

Stone and Nofziger (1993) reported that wide spaced furrow irrigation can often produce acceptable or similar yields of cotton with 38 per cent saving of water and achieving overall irrigation efficiency more than 15 per cent of every furrow irrigation.

2.2 Irrigation Scheduling :

Scheduling of irrigation becomes a more complicated matter in case of micro irrigation compared to that of broad bed furrows irrigation. The past work on pan coefficient, evapotranspiration soil moisture depletion and cumulative pan evaporation, IW/ CPE ratio is reviewed here.

Subramaniam et al. (1974) conducted a field trial to study the optimum moisture stress at different growth stages of groundnut using climatological approach. Results indicated that groundnut irrigated at 0.9 ratio between irrigation water and cumulative pan evaporation recorded higher yields compared to 0.6 ratio of IW/ CPE.

Doorenbos and Pruitt (1977) reported that the water requirement of specific crop in drip irrigation can be calculated from an open pan evaporation. To relate pan evaporation (Epan) to crop evapotranspiration (ETc)) empirically derived pan coefficient (Kp) are given to take into account the setting of pan and pan environment while crop coefficients are given to account for the effect of crop characteristics on crop water requirements.

Narashimham *et al.* (1977) revealed that semi erect short season varieties of groundnut irrigated at 75, 50 and 25 per cent soil water depletion during dry season in India. Irrigation at 25 per cent SWD gave the highest yield but lowest water use efficiency. Irrigation at 75 per cent SWD gave high WUE but significantly

lower yield. Scheduling irrigation at 50 per cent SWD was good compromise which gave good water use efficiency with no significant yield reduction.

Thosar *et al* (1992) studied the effect of irrigation scheduling on yield of summer groundnut during summer of 1982, 1983 and 1984. Scheduling irrigation at 75 percent available soil moisture with mulch of wheat straw recorded higher pod yield followed by irrigation at 0.75 IW/CPE ratio (80 mm CPE) with mulch and irrigation at different phenological stages of crop growth.

Tiwari *et al.* (1997) conducted a field experiment in 1993-94 at Udaipur on groundnut Cv. GG-2 . The crop was irrigated at IW/CPE ratios of 0.4, 0.7 and 1 and applied 20:40, 30:60 and 40:80 kg of N : P₂O₅/ha. Weed control treatments followed with earthing up found that pod yield increased with IW/CPE of 0.7 and the application of 30 : 60 kg of N : P₂O₅/ha.

2.3 Design and Arrangement.

The efficiency of the irrigation system may be governed by arrangement of the system, pressure in the system, discharge through outlets, spacing between furrows, width of broad bed. Proper arrangement of system has prime importance because it saves cost and energy.

Patil (1989) conducted a trial on black soil (pH 6.5) in the post rainy season of 1988. Groundnut sown on broad beds (1.2 m x 5 m) with a 30 cm irrigation furrow between two beds and on a flat seedbed (5 m x 5m) for basin irrigation. Gypsum at 0.5 t/ha was applied at the peg formation stage near the crop rows on the broad beds. Cultivation on broad beds markedly increased the number of efficient pegs per hill and gave pod yield of 4.05 t/ha compared with 2.19 t/ha for control basins.

Camp *et.al.* (1997) found that the cost of drip irrigation can be reduced by using both wider lateral spacing and by also using the same lateral for multiple years. Need of N fertilizer and water application by improving efficiency and limiting the potential for leaching. They evaluated three side dress nitrogen methods with two subsurface lateral spacing. The limit yield did not differ between the lateral spacing in any year.

Lamn *et al.* (1997) conducted an experiment to determine the optimum drip line lateral spacings for irrigated corn using subsurface drip lines installed at a depth of 40-45 cm parallel to the corn rows in silt loam soils. The drip line spacing were 1.5, 2.3 and 3.0 m for a seasonal irrigation amount of 462 mm. The yield decreased with increase in horizontal distance from the pipelines as wider spacing resulted in non uniform distribution of available water. The highest yield, highest water use efficiency and lowest variation were obtained with 1.5 m drip line spacing.

Ghetia *et al.* (1998) stated that in case of drip irrigation the required quantity of water was applied at 0.8 fraction of cumulative pan evaporation (80 per cent of CPE) on alternate day. The groundnut Cv. GG-2 was sown using recommended seed rate of 125 kg kernel /ha keeping inter and intra spacing of 30 and 10 cm respectively. The lateral pipe was laid out in plot at 60 cm distance. The dripper were fitted on lateral line at a distance of 45 cm. Normal operating pressure was maintained at 1.2 kg/cm².

2.4 Spacing and time of sowing or Dibbling.

Spacing and time of dibbling may ultimately affect the yield of groundnut.

Bhosale *et al.* (1987) conducted an experiment at Marathwada Agril. University, Parbhani. They observed that dry pod yield due to sowing on 1st February and 15th February was comparable and significantly higher than 2nd March sowing.

Deshmukh *et al.* (1987) conducted trials at Dr. PDKV. Akola (M.S.) with row spacing viz. 20, 30 and 40 cm were at par giving 1222 to 1240 kg of dry pod yield. In another experiment on spacing, the effect of three spacings of 30 x 15 cm, 45 x 10 cm, and 45 x 15 cm were not significant.

Biradar *et al.* (1988) reported highest pod yields of 2.74 to 2.79 t/ha with plants spacing of 10 or 15 cm apart in rows, 30 cm apart as compared to 2.19 to 2.67 t/ha pod yield in other treatments of 20 and 40 cm row spacings.

Rao and Rao (1989) conducted trial in 1984-85 and reported that delay in sowing groundnut Cv. TMV-2 on 6 dates at 15 days interval between 1 Dec and 16 February progressively reduced pod yield from 2.13 to 0.73 t/ha.

Pawar *et al.* (1991) conducted a field trials on clay soil to observe the effect of sowing on 15 and 25 January or 4 Feb and irrigation at critical growth stages at 10 days intervals at 75mm CPE or at 50 per cent depletion of available soil moisture on yield and yield attributes of groundnut Cv. SB-XI. Number of gynophores pods per plants, test weight and concluded that pod yield increased with delay in sowing date.

Jadhao *et al.* (1992) conducted an experiment on optimum spacing for groundnut varieties during summer season of 1986, 1987 and 1988. The soil of experimental field was medium black vertisol having pH 7.4 and low in total nitrogen, medium in available phosphorus, and slightly high in potassium. Two varieties (V₁ – S B –XI and V₂ – UP 70103) and six spacings (30 x 10, 30 x 15, 30 x 20, 45 x 10, 45 x 15 and 45 x 20 cm) with three replications were tried in the FRBD. A dose of 25, 50:0 NPK fertilizer kg/ha was applied at sowing. Haulm yield and pod yield was more in the 30 x 10 cm on spacing because of high density.

2.5 Water requirement and saving :

As water being a limited resource, its efficient use is basic to the survival of ever increasing population of the world. In many areas, water supplies are highly variable and are chronically insufficient to irrigate all the land under individual holdings. Under these conditions, determination of crop water requirements by different irrigation systems is extremely valuable.

Shinde and Pawar (1984) reported that crop coefficient for summer groundnut at various growth stages were 0.353 during sowing to establishment (19 days), 0.594 during seedling to 50 per cent flowering (27 days), 0.754 during 50 per cent flowering to pegging (23 days), 0.944 during pegging to pod formation (20 days) and 1.096 during pod formation to pod maturity (24 days) at different IW / CPE ratio as 0.4, 0.6 and 0.8.

Patil and Dongale (1986) reported that 33 and 50 per cent water saving with sprinkler and drip system respectively over conventional system of irrigation. Sprinkler irrigation saved 33.33 per cent water and increased of yield from 22.22 to 29.17) q/ha over conventional system of irrigation.

Sable and Khupse (1986)^a found that total water use by groundnut crop was directly related to the level of available soil moisture kept throughout the crop growth. Thus the consumptive use of water was found to be 572.73 and 545.37 mm in 45 to 50 per cent available soil moisture treatment in 1976 and 1977 respectively. Similarly in the treatment of 80 to 85 per cent available soil moisture the consumptive use was 586.76 and 563.50 mm in 1976 and 1977 respectively. The total daily consumptive use of water was found to be maximum when irrigation was applied at 80 to 85 per cent available soil moisture.

Kulkarni (1987) reported 32 per cent saving of water and 14 to 42 per cent increase in yield of groundnut Cv. SB XI when irrigated by sprinklers over conventional furrow irrigation at Vadegaon and Phalton farm.

Patil (1988) reported that 21 per cent more ground nut pod yield with 33 per cent less water with sprinkler system of irrigation as compared to check basin irrigation.

Anonymous (1989) conducted experiment at water management project, Rahuri in the year 1988-89 for estimation of consumptive use of summer groundnut (ICGS-11) by lysimetric technique. It was observed that total water requirement of summer groundnut was 819.5 mm with nine irrigations for production of 34.19 q/ha of dry pods on medium black soil.

Ramchandraappa and Kulkarni (1992) revealed that an IW / CPE ratio of 0.5 during 10-40 days after sowing and later at 0.75 IW/CPE ratio resulted in higher pod yields and water use efficiency with saving of 40 mm of water compared with uniform irrigation at 0.75 IW/ CPE ratio throughout crop growth. Total water use and seasonal consumptive water use increased with increase in number of irrigations.

Anonymous (1995)^b evaluated the microirrigation systems with different emission devices in summer groundnut. The emission uniformity was observed more than 90 per cent in all the microirrigation systems. The maximum Emission Uniformity (94.00 per cent) was observed in biwall irrigation system. Due to micro-irrigations, water saving was observed to the extent of 27-30 per cent over border irrigation. Maximum dry pod yield of 32.76 q /ha was observed in microsprinkler irrigation followed by 31.53, 31.08 and 30.34 q/ha in drippers (turbo key), biwall and micro tube irrigation systems, respectively. Minimum yield of 22.64 q/ha was observed in border irrigation. Similarly, maximum water use efficiency (0.50 q/ha-cm) was observed in micro-sprinkler irrigation system.

2.6 Effect of Soil Types On Production Of Groundnut

Katre *et. al.* (1988) conducted trials with groundnuts on sandy clay loam soil of Bilaspur, and observed that irrigation with 7 cm water per irrigation at IW/CPE ratio of 1.2, 0.9 and 0.6 gave average pod yield of 32.63, 27.33 and 22.92 q/ha respectively.

Kadam and Patil (1989) studied response of groundnut to irrigation on lateritic soils of konkan and found that irrigation scheduling with 40 to 60mm depth at 1.00 or 0.75 IW/CPE ratio, are identical in their effect in respect of haulm and pod yield, as also shelling percentage and were significant over 0.5 IW/CPE ratio. They concluded that groundnut crop can not be stressed for water beyond 0.75 IW/CPE ratio irrespective of the depth of water on lateritic soil.

Khan and Datta (1990) studied the irrigation scheduling effect in sandy loam soil and recommended IW/CPE ratio of 0.75 for groundnut Cv. SB-XI as the optimum irrigation index for potential yield and water use efficiency in the pertaining agroclimatic conditions and effective rootzone and 6 cm net irrigation was considered to be best irrigation depth.

Desai *et. al.* (1992) conducted a field experiment by using 3 groundnut cultivars and 4 irrigation regimes on a clay soil. IW/CPE ratio and variety interaction affected yield, oil content significantly, but not protein content of kernels.

2.7 Irrigation Efficiencies

It deals with efficient use of water by changing the technique or system application in order to get maximum productivity per unit water consumed. Following reviews are presented herewith related to irrigation efficiencies.

Wu and Gitlin (1975) worked on the irrigation efficiencies of surface, sprinkler and drip irrigation and observed that the distribution efficiency was found to be 80 per cent or more and 90 per cent or more in case of surface and drip irrigation system respectively. He also observed that the application efficiency in case of surface, sprinkler and drip irrigation was found to be 50 to 60 per cent, 60 to 70 per cent and 90 per cent or more respectively.

Sammis (1980) reported the highest water use efficiency in trickle and subsurface system with water application occurring when the soil water potential at the 15 cm depth reached - 60 Kpa. The highest WUE with potatoes were achieved with trickle and subsurface irrigations. The sprinkler and furrow irrigations gave lower water use efficiency.

Gutal *et al.* (1988) studied microsprinkler irrigation in groundnut. They observed the wetted soil diameter when the system was operated at 1.5 kg/cm² pressure with spacing of 3 m x 3 m, 3.3 mm/hr application rate and 30 cm stake height. The uniformity coefficient (UC) and distribution efficiency (DU) of the microsprinkler were reported as 60.8 and 36.4 per cent respectively.

Mankar (1989) concluded that the conveyance efficiency for drip was 100 per cent, application efficiency was ranging from 86.92 to 83, 21 per cent and distribution efficiency for drip was found to as high as 92.35 to 94.18 percent

Anyoji and Wu (1994) found that the flow and emitter discharge along lateral line could be considered to have normal distribution. So the probability density function and the cumulative probability density of normal distribution can be applied to derive equations for irrigation application efficiency, storage efficiency, deep seepage and deficit, the location of required irrigation depth in normal distribution and coefficient of variation of emitter flow of the drip irrigation system

are expressed as function of α value . A simple drip irrigation schedule was developed by setting the α value to zero, so that the irrigation application efficiency , storage efficiency, deep seepage and deficit can be expressed only as function of variation of emitter flow. The coefficient of variation of emitter is found less than 21 per cent and both the irrigation application and storage efficiency were greater than 92 per cent

Anonymous (1995)^a studied the performance of different planting techniques for economic design of micro irrigation system in summer groundnut. The pressure discharge relationship of microsprinkler was found very excellent with values of $R^2=0.99$. UC values of microsprinkler were found near about 90 per cent. On the basis of UC and EU of microsprinkler, spacing of 1.5 x 1.5 m was recommended. In drip irrigation 66 per cent of total area was considered for irrigation and thus 17.47 cm (66 per cent of ETc i.e. 26.32 cm) depth of irrigation was applied. Twenty four cm water was applied in microsprinkler treatment as against five irrigation, each of 6 cm in BBF treatments. Maximum yields as well as water use efficiency (38.49) q/ha and 158.96 kg/ha-cm were observed in micro sprinkler treatment. The increase in yield and water saving were 47.41 and 27.13 per cent, respectively when compared to control treatment of surface irrigation.

Arakrao (1995) reported that maximum field water use efficiency was recorded in 3 row broad bed furrows (132.25 kg/ha-cm) which was significantly superior over all treatments; 2 row BBF (116.70 kg/ha-cm) stand next to 3 row BBF. Field water use efficiency obtained in check basin and 4 row BBF were at par with each other. The minimum field water use efficiency was obtained in border treatments (69.78 kg/ha-cm).

Patel *et al.* (1998) observed that irrigation scheduled at different irrigation fractions of pan evaporation (FPE) i.e. 0.2, 0.4, 0.6 and 0.8 gave significantly higher groundnut pod yield over surface irrigation of 80 mm depth. All FPE were at par statistically. The higher yield obtained under different FPE was mainly due to better soil water regime. There was saving of water from 31 to 73 percent under different fractions and highest was with 0.2 FPE. The water expense

efficiency (WEE) was higher (0.3 kg/ha-mm) with 0.2 FPE and decreases with increase in the fractions of pan evaporation.

Pawar *et al.* (1998) observed that uniformity coefficient was more for 50 cm stake height than 20 cm stake height at larger microsprinkler spacing (2.25m and above) and less at smaller microsprinkler spacing (2 m and below). In case of microsprinkler the maximum depth of water was near the microsprinkler and there was drastic reduction in depth as one moves away from the microsprinkler. The treatment with minimum micro sprinkler spacing recorded the highest yield of garlic (5744 kg/ha) and was significant over all treatments. The yield decreased with microsprinkler spacing such that treatment with maximum spacing recorded lowest yield (3557 kg/ha).

2.8 Soil moisture and salt distribution pattern :

It determines the horizontal as well as vertical movement of water through point source of application and salt deposition at various locations around the root zone of crop.

Swaminathan (1972) stated that in case of drip irrigation system, moisture regime was around the field capacity zone. The distribution of water around the point sources is longitudinal overlapping of wetting front of successive drippers. The ultimate moisture distribution is two dimensional. In case of furrow system, the movement of water was normal to furrow shape.

Clotheir *et al.* (1985) stated that the movement of water into the soil under drip emitter occurred in response of equidimensional capillary attraction of downward movement as a result of gravity. They also concluded that soil texture determine the relative importance of gravity and capillary forces.

Magar *et al.* (1985) studied the soil moisture distribution in black soil. They reported that the vertical and radial distribution was in radius of 25 cm from emitter at the surface. They also found that the water movement was vertically much more than horizontally.

Moshrefi and Beese (1985) studied effect of irrigation system on salt and root distribution of chile pepper plant, at Goeltingen, west Germany. They

observed that in the surface irrigation treatment a concentration of salt was parallel to soil surface. The zone of accumulation of salt was observed around the dripper. The zone of accumulation extended to lower depth with increasing amount of irrigation.

Bhuyar (1987) observed that under drip irrigation the accumulation of salt was found to be maximum at the periphery of wetted area.

Gutal *et al* (1989)^b reported that uniformity coefficient of microsprinkler kept at 1.2m X 1.2m spacing and at 30 cm stake height was 76.8 per cent at 1 kg/cm² operating pressure. They observed that precipitation rate decreased with increase in stake height. The maximum wetted diameter of soil was reported as 3.30 m at 30 cm stake height with precipitation rate of 4.00 mm/hr. Whereas it was 3.10 m at 45 cm stake height with precipitation rate of 3.4 mm/hr.

Firake and Salunke (1992) studied in the field the movement of moisture in sandy clay loam soil at 15, 20 and 25 m operating pressure head of the micro sprinkler system. They observed that the soil moisture at any depth and time decreased with increase in head. They further concluded that more the operating pressure more will be time to saturate the rootzone and vice versa.

Phadtare *et al* (1992) conducted a field experiment to study the moisture distribution pattern in drip irrigation in vertisol. Fixed quantity of water (12 lit.) was applied during test with different emitters discharge viz. 2,3,4 and 5 lph using small trickle units with single point source. A surface radial spread of 31.0 cm and 26.25 cm were observed for the lowest (2 lph) and highest (5 lph) discharge respectively. The vertical advances were 105.65 and 118.50 cm for 2 lph and 5 lph emitter discharges respectively, indicating that the radial spread at surface was more for lower discharges where as vertical advances was more for the higher discharge. The maximum radial spread of 56.79 cm was observed at 51.61 cm below the soil surface for 2 lph emitter discharge.

Goel *et al* (1993) studied the effect of different discharge rates of dripper on moisture distribution in soil. The iso moisture content line in terms of per cent moisture content for horizontal and vertical movement of water was drawn.

They concluded that the water at higher discharge saturate the soil near the dripper and infiltration was lower whereas the water penetrated deeper with lower application rate because of availability of more time for infiltration.

2.9 Growth, yield and quality of summer groundnut

Patel and Patel (1980) conducted an experiment at Jyoti farm, Baroda to compare border, sprinkler and drip irrigation systems for groundnut crop. The results showed that the yield was higher by 45 per cent and 66 per cent due to drip irrigation compared to sprinkler and border system respectively. They also reported that inspite of high cost of drip system additional net returns of Rs. 1159/ha were also obtained compared to other systems of irrigation.

Katri and Patel (1983) developed a model for groundnut yield prediction over a range of moisture regimes and suggested that critical stages for irrigation were germination, vegetative development, full pegging and pod development in Gujrath,

Pawade (1984) compiled the research review on soil and water engineering and presented the report to Maharashtra Agril. University joint Agresco. He reported that studies conducted at MPAU, Rahuri on comparison of sprinkler with border system of irrigation showed that in case of groundnut and garlic, per cent increase in yield due to sprinkler irrigation of 5 cm was found to be 45.45 and 11.15 per cent respectively. The another study conducted on sprinkler system of irrigation for summer groundnut Cv. SB-XI and chilli (Jwala) per cent increase in yield due to sprinkler irrigation was found to be 29 per cent and 23 per cent respectively over border system of irrigation.

Anonymous (1988) reported that maximum pod yield of groundnut were obtained due to furrowing i.e furrow opened every three row of groundnut when compared with BBF and flat beds type layout.

Babalad and Kulkarni (1988) found that treatments receiving frequent irrigation at week interval, 50mm CPE and 50 per cent available soil moisture depletion, recorded significantly higher plant height, number of leaves, and dry matter accumulation as compared to less frequently irrigated treatments. They

revealed that irrigation at 50 per cent available soil moisture gave pod yield of 4.89 t/ha where as the lower yield i.e. 4.65, 4.13 and 4.47 t/ha were obtained with irrigation at 50, 75 and 100 mm CPE respectively.

Patel *et al.* (1990) conducted an experiment on evaluation of three irrigation system viz. flood, sprinkler and drip on summer groundnut during 1986-87 and 1988-89 at Gujarath Agril. University, Junagadh. The results revealed the superiority of drip system of irrigation recording higher mean yield of 2155 kg/ha, net profit of Rs. 1538 /ha and water saving of 42 per cent over flood system of irrigation.

Kachroo and Walia (1991) reported that higher pod yield higher water use efficiency and oil yield of groundnut at CPE 75 mm as compared to other treatments at Ludhiyana.

Rao *et al.* (1991) conducted an experiment in 1990 at Regional Agril. Research station, APAU, Jagital (AP). They reported that groundnut Cv ICGS-11 and Kadiri-3 gave dry pod yields of 2.9 and 3.9 t/ha respectively in flat bed system and 4.8 and 3.6 t/ha in BBF system respectively.

Deshmukh and khandkar (1998) found that variety TG-26 has got higher shelling outturn (72-76 per cent); moderate 100 pods weight (80-85 gm); moderate 100 kernel weight (34-45 gm); normal oil content (50-51 per cent). They also stated that distinguishing, morphological character of TAG-24 variety was semi dwarf plant (15-20 cm height), small and dark green leaflets, 1-2 seeded and occasionally 3 seeded pod with smooth shell, light rose test, early maturing, compact plant type and high harvest index. This variety responded well to closer spacing (30x10 cm) with seed rate 125 kg/ha.

Vaghamsi *et al.* (1998) observed that most of growth character like plant height (cm), number of primary branches per plant and dry matter production were significantly increased by N (25 kg/ha) application over control. It resulted into the highest haulm yield of 49.91 q/ha.

2.10 Cost Economics :

Kaushal and Pathak (1977) worked on economics and WUE of sprinkler versus border irrigation dunes. They concluded that with sprinkler irrigation the yield of wheat, groundnut and cotton were 27.5, 11.9 and 10.09 q/ha respectively, while with border irrigation the yields of wheat, groundnut and cotton were found to be 32.00, 5.5 and 15.09 q/ha respectively. Gross benefit cost ratio was 1.3, 1.7 and 1.5 respectively with sprinkler irrigation while border irrigation the ratio was found to be 1.8, 0.9 and 2.2 respectively.

Padmakumari and Sivanappan (1989) reported that improved cropping scheme with drip irrigation resulted in an average net gain of Rs. 4711/ha as against Rs. 3290/ha in conventional systems.

Jadhao (1993) conducted an experiment on sugarcane in respect of cost economics of drip irrigation over furrow irrigation and reported net return of Rs. 8707 per ha under drip irrigation.

Inamdar *et al.* (1996) conducted a comparative analysis of the investment costs, operating costs and returns of lift irrigation and biwall drip irrigation. Data were collected from a sample of 98 sugarcane growing farmers in the command area of lift irrigation scheme in Sangli district (M.S.) both before and after installation of biwall drip irrigation units. The biwall drip irrigation unit proved to be profitable with a benefit cost ratio of 1.43 in command area.

Moll and Charisten (1996) carried out a financial analysis to compare the costs and benefit of irrigation system (flood, drip, Riverina twin furrow) for vineyards. Drip irrigation ranked first. Over the 15 years cultivation period, drip irrigation had a 10 per cent higher net profit value than the other system. Riverina twin furrow was marginally better economical than flood irrigation due to smaller evaporation basin area.

CHAPTER III

MATERIAL AND METHODS

Information on basic resources, material and systems employed during the course of investigation are presented in this chapter.

3.1 Basic Resources Information

3.1.1 Experimental site

The experiment was conducted from 2nd February 2000 to 26th May 2000 on the research farm of Department of Irrigation and Drainage Engineering, Dr. P.D.K.V., Akola. The site is situated just behind the college of Agricultural Engineering and Technology. The experimental field was fairly levelled and uniform.

3.1.2 Location, climate and weather conditions of experimental site

Akola is situated in Vidarbha region of Maharashtra State and comes under subtropical zone. It is situated at an altitude of 307.415 m above mean sea level (MSL) at the intersection of 20^o42' north latitude and 77^o02' east longitude. Average annual precipitation is 760 mm, out of which approximately 86 per cent is received during June to September.

The climate of the area is semiarid, characterized by three distinct season, namely summer being hot and dry from March to May, the warm and rainy monsoon from June to October and winter with mild cold from November to February.

The mean annual maximum and minimum temperatures are 39.35^o C and 22.50^o C in summer and 29.57^o C and 12.13^o C in winter respectively. The climatological data were recorded daily from the meteorological observatory. Department of Agronomy, Dr. P.D.K.V., Akola during the period of investigation and is presented in Appendix 'A'.

3.1.3 Soil of Experimental plot

Physical and chemical tests were carried out on the composite soil sample prior to dibbling of kernels in the plot to know mechanical and chemical composition of the experimental plot soil. The composite soil sample was prepared according to the procedure suggested by the Deptt. of Agril. Chemistry and Soil Science Dr. P.D.K.V., Akola. Soil samples were collected from four corners of the field and one from the centre through V shaped pits dug up to a depth of 30 cm. They were mixed thoroughly and approximately 0.5 kg was taken for the tests.

Physical analysis was done as per the standard procedure to know the physical property of the soil. Similarly standard procedure was used to perform chemical analysis of the soil. The results of these analysis are presented in Table 3.1

Table 3.1 Mechanical and chemical composition of the experimental soil

| Sr. No. | Particulars | Observation |
|---------|---|--|
| A) | Mechanical composition, 1) Sand % 2) Silt % 3) Clay % 4) Soil texture class | 35.63 30.08 34.29 Clay loam |
| B) | Chemical composition 1) Organic carbon % 2) Available Nitrogen (kg/ha) 3) Available P ₂ O ₅ (kg/ha) 4) Available K ₂ O (kg/ha) 5) EC, dS/m 5) p ^H | 0.385 % 268.8 kg/ha 22.9 kg/ha 537.6 kg/ha 0.29 7.5 |

The soil moisture constant in terms of field capacity and permanent wilting point was determined using the standard procedure suggested by Michael (1978). The results are presented in Table 3.2

Table 3.2 Soil moisture constants of experimental plot

| Sr. No. | Particulars | Depth 0-30 cm |
|---------|-------------------------------------|---------------|
| 1. | Field capacity (per cent) | 32.00 |
| 2. | Permanent wilting point (per cent) | 15.07 |
| 3. | Bulk density (g/cc) | 1.20 |

3.1.4 Water source and its quality

The source of water on the experimental plot was kaulkhed lift irrigation system which lifted water from Morna river. The water from the source was conveyed to the irrigation and Drainage Engineering Department through pipeline and stored in a cement tank. The water from the tank was supplied to the field through a centrifugal pump. Before start of experiment, water was analyzed for its quality to evaluates different parameters. The results are presented in Table 3.3

Table 3.3 Chemical analysis of irrigation water

| Sr. No. | Particulars | Observation |
|---------|-----------------|-------------|
| 1. | PH | 8.70 |
| 2. | EC (dS/m) | 0.79 |
| 3. | CO 3 (meq/l) | 1.40 |
| 4. | HCO3 (meq/l) | 1.00 |
| 5. | Cl (meq/l) | 5.20 |
| 6. | Ca + Mg (meq/l) | 5.40 |
| 7. | Na (meq/l) | 2.40 |
| 8. | SAR | 1.46 |

3.2 Experimental set up :

The crop was irrigated by four different irrigation treatments for collecting data required to carry the investigation. A suitable set up was required for irrigation purpose .Firstly for land preparation, deep ploughing was done once by means of tractor drawn disc plough to the depth of 20 cm. Clod crushing was done by cultivator and land smoothening and pulverizing the soil by krushivator was done. During pulverising folidal dust powder was thoroughly mixed in the soil to avoid soil born diseases. The stubble were collected to make the field clean. Thus soil was brought into fine tilth and land was made suitable for dibbling operation.

Accordingly the lay out was prepared and the pipelines for irrigation was installed. The plan of experimental layout with necessary details is shown in fig. 3.1.

The irrigation system consisted of pump, suction pipe, delivery pipe, emitters, microsprinklers and other accessories such as flow control valve, tee, elbow, coupling, plugs, reducer, G.T.O. and thread piece, etc.

3.2.1 Pump :

The horizontal volute centrifugal pump directly coupled with electric motor was used to supply water from storage tank to the head unit of the system. The specifications of the pump are as follows

| | | |
|----------|---|-----------------------------------|
| Make | : | Crompton Greaves induction motor. |
| Type | : | Centrifugal, volute casing |
| Speed | : | 1440 rpm |
| HP | : | 3 |
| Capacity | : | 147 lpm |
| Head | : | 45 m |

3.2.2 Suction pipe :

Suction pipe was used to lift the water from the storage tank by pump. A 8.5 m long polyvinylchloride (PVC) pipe of diameter 63 mm was used as suction pipe. A foot valve was provided at the bottom of this pipe along with strainer, to check the inflow of impurities.

3.2.3 Delivery pipe

Delivery pipe was used to supply water to the head unit of irrigation system for which, a 63 mm polyvinyl chloride (PVC) pipe was used.

3.2.4 Main line

Main line carried irrigation water from the head unit to the submain. A 103 m long poly vinyl chloride (PVC) pipe of 63 mm diameter and 6 kg/cm² pressure class . It was buried below the soil surface .

3.2.5 Submain line

Submain line carried irrigation water from main line to laterals of drip microsprinkler, drip inline and broad bed furrows . A poly vinyl chloride (PVC) pipe of 40 mm diameter and 6 kg/cm² pressure class was used. Four submain were used each of 21 m length.

3.2.6 Laterals

Laterals were used to convey the irrigation water from submain to the plants through dripper . Pipe made with low density polyethylene material were used as laterals. Length of each later was 24 m with 12 mm diameter. The lateral were connected to each submain by G.T.O.

Dripper

Low density polyethylene (LDPE) laterals of 12 mm diameter were connected by grommet take off (G. T.O) to submain line to convey irrigation water from submain line to respective experimental plot. Turbo key dripper of 4 lph discharge rate at 1.0 kg/cm² pressure were connected to laterals with a spacing of 60 cm between two drippers. Lateral was laid down in plot by keeping a spacing of 60 cm between two turns.

Microsprinkler

Low density polyethylene (LDPE) laterals of 12 mm diameter were used to convey irrigation water from submain to respective plot. Microsprinkler, assembly consists of microsprinkler, stake and microtube. Microsprinkler were connected to lateral by microtube and installed in the field by means of 50 cm long stake .

For microsprinkler irrigation treatments 2 micro sprinkler were provided with spacing of two meter between them for each plot. Each microsprinkler has a average of 3.6 m. range at 1.0 kg/cm² pressure and discharge of 91 lph.

Drip inline

The integrally build drip inline laterals manufactured by national organic chemical industry limited. Akola. The laterals having a diameter of the 12 mm discharge outlet at a distance of 60 pressur cm giving 3 lph discharge per outlet under pressure of 1.0 kg/cm² was used.

3.2.7 Control head unit

Pump was being used for various purpose of the departmental activities. Hence the required amount of water was delivered from pump into main line through control unit. The control unit comprised of sand filter, screen filter pressure gauge, water meter, flow control valve, pressure regulating valve.

1) Sand filter :- The sand filter was used to remove impurities from the irrigation water. It consists of a large metal tank. The water entering the strainer top is passed through the filtering media (Sand) to prevent entry of foreign material in the pipe network of the system.

2) Screen filter:- It was used to avoid clogging of water drippers in pressurised irrigation system. The water has to be filter before approaching the drippers

3) Pressure guage :- It was used to measure the pressure developed in the system of irrigation pipelines.

4) Water meter :- It was used to measure the amount of water passed to the field through pipelines.

5)Flow control valve :- It was used to control water flow in the irrigation system.

6)Pressure regulating valve :- It was used to regulate pressure of water inflow into the system.

3.2.8 Accessories

Water distribution unit consisted of PVC tees, elbows, reducer and flow control valve. Water from the main was divided into four submains with the help of flow control valves. Threaded end cap was used at the end of submain for delivering the flow of water to broad bed furrow. Gromet take off was used to connect the lateral to the submain. End plugs were used to plug the water flow at the end of the laterals.

3.3 Experimental Details

3.3.1 Mode of conveyance of water in the field

In drip, microsprinkler, drip inline irrigation treatments, three submain were used to irrigate each replication. Laterals were connected to each submain through G.T.O. Flow control valve was used to regulate flow of water through submain.

In BBF irrigated treatments, water was applied at 40 mm CPE. Water was conveyed through pipe to each BBF irrigated plot to prevent the conveyance losses.

3.3.2 Experimental design and treatments

The present investigation was carried out with four treatments of irrigation systems with five replications in randomized block design. The details of layout and treatments are given below.

3.3.3 Details of irrigation treatments.

| Sr. No. | Treatment | Specifications |
|---------|----------------|------------------|
| 1 | T ₁ | Drip |
| 2 | T ₂ | Microsprinkler |
| 3 | T ₃ | Drip inline |
| 4 | T ₄ | Broad bed furrow |

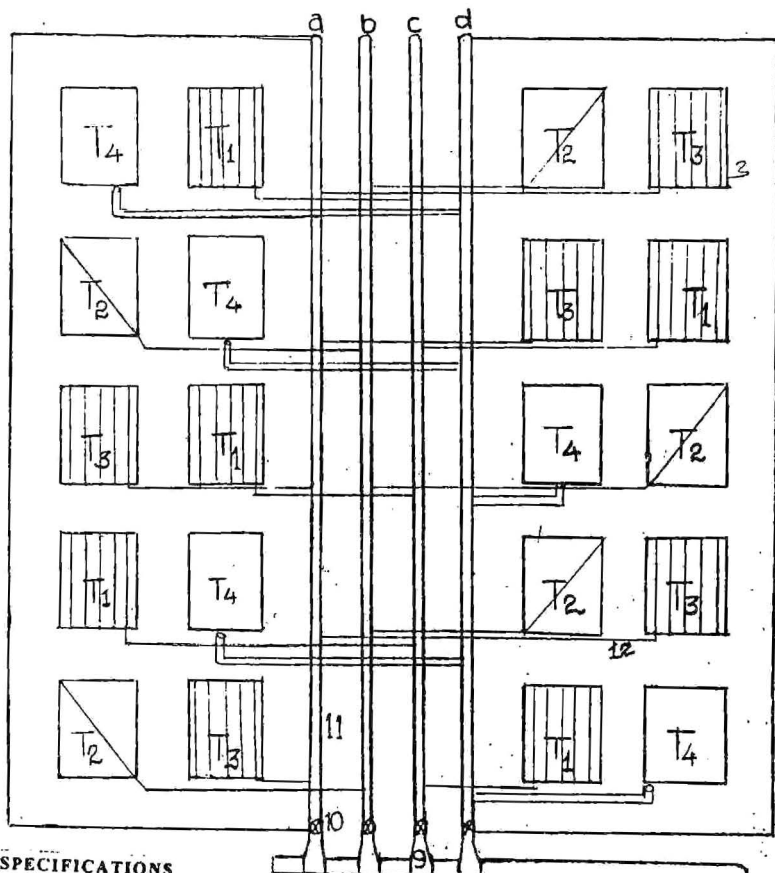
3.3.4 Details of layout

The present investigation was carried out with four treatments of irrigation systems with five replication in randomized block design. The details of layout and treatments are given below.

| Sr. No. | Particulars | Specification |
|---------|--------------------------------------|----------------------------|
| 1 | Crop | Summer Groundnut |
| 2 | Scientific name | <i>Arachis hypogaea L.</i> |
| 3 | Variety | TAG - 24 |
| 4 | Experimental design | Randomized Block Design |
| 5 | Number of replications | Five |
| 6 | Number of treatments | Four |
| 7 | Number of plots | 20 |
| 8 | Net plot size | 2.7 x 3 m |
| 9 | Interspace between replications | 1 m |
| 10 | Season | Summer (1999-2000) |
| 11 | Crop spacing | 30 x 10 cm |
| 12 | Seed rate | 125 kg/ha |
| 13 | Recommended fertilizer dose (N.P.K.) | 25:50:00 kg/ha |
| 14 | Duration of crop | 110-115 days |
| 15 | Date of sowing | 2nd February |
| 16 | Date of harvesting | 26th May |

3.4 Water requirement of summer groundnut

Before sowing, irrigation was applied on 31st January 2000 to the field for better and uniform germination. Kernels were treated with thirum @ 2.5 g/kg seed. Seed was sown at spacing of 30 x 10 cm by dibbling one seed per hill. Sowing was done on 2nd February 2000. The first irrigation was given on 2nd February 200 upto field capacity in all treatments. In drip, microsprinkler, drip inline treatments water was applied daily at the rate of 100 per cent crop ET. and in broad bed furrow irrigation treatment water was applied when CPE reached to 40 mm. The amount of irrigation water required for all treatment to bring it upto field capacity was calculated by equation 3.1



SPECIFICATIONS

1. STORAGE TANK
2. PUMP WITH MOTOR
3. BYPASS
4. PRESSURE GAUGE
5. SAND FILTER
6. SCREEN FILTER
7. NON RETURN VALVE
8. MAIN LINE
9. TEE
10. FLOW CONTROL VALVE
11. SUBMAINS
12. a. Drip in line b. MICROSPRINKLER
c. DRIP d. BBF.
- LATERALS

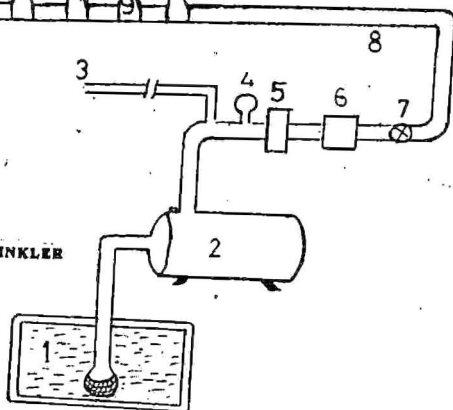


Fig. 3.1 Different irrigation systems layout for experimental plot.



Plate 3.1 Overall view of experimental plot

3.4 Water requirement of summer groundnut :

Before sowing irrigation was given on 31st January 2000 to the field for better and uniform germination. Kernels was treated with thirum @ 2.5 g/kg seed. Seed was sown at spacing of 30 x 10 cm by dibbling one seed per hill. Sowing was done on 2nd February 2000. The first irrigation was given on 2nd February 200 upto field capacity in all treatments. In drip, microsprinkler, drip inline treatments water was applied daily at the rate of 100 per cent crop ET. and in broad bed furrow irrigation treatment water was applied when CPE reached to 40 mm. The amount of irrigation water required for all treatment to bring it upto field capacity was calculated by equation 3.1

$$d = \frac{Mfc - Mbi}{100} \times As \times Ds \quad \text{---(3.1)}$$

In which,

d - Net amount of water to be irrigated during an irrigation, cm

Mfc - Moisture content at field capacity, per cent

Mbi - Moisture content before irrigation per cent.

As - Bulk density of soil, gm/cc

Ds - Depth of effective rootzone, cm

Quantity of water required per plot in litres was calculated by using equation 3.2

$$Q = d \times A \quad \text{---(3.2)}$$

In which,

Q = Quantity of water required per plot, litres.

d = Net amount of water to be applied during an irrigation, mm

A = Area of plot, m².

The effective rootzone depth was taken as 30 cm for calculating the net water requirement of summer groundnut crop.

3.4.1 Water requirement of drip, microsprinkler and drip inline system.

$$d = \frac{Mfc - Mbi}{100} \times As \times Ds \quad \text{---(3.1)}$$

In which,

d - Net amount of water to be irrigated during an irrigation, cm

Mfc - Moisture content at field capacity, per cent

Mbi - Moisture content before irrigation, per cent.

As - Apparent specific gravity.

Ds - Depth of effective rootzone, cm

Quantity of water required per plot in litres was calculated by using equation 3.2

$$Q = d \times A \quad \text{---(3.2)}$$

In which,

Q = Quantity of water required per plot, litres.

d = Net amount of water to be applied during an irrigation, mm

A = Area of plot, m².

The effective rootzone depth was taken as 30 cm for calculating the net water requirement of summer groundnut crop.

3.4.1 Water requirement of drip, microsprinkler and drip inline treatments.

The daily water requirement of drip, microsprinkler, drip inline irrigation treatment was worked out on the basis of class 'A' open pan evaporation.

The values of crop coefficient for different growth stages of crop are presented in Table 3.4 (Sambasiva Rao and Subramaniam, 1985).

Table : 3.4 crop coefficient values for summer groundnut crop :

| Sr. No. | Crop stages | Growth period | Crop coefficient |
|---------|------------------|-----------------------------|------------------|
| 1 | Initial | 2 nd Feb- 21 Feb | 0.45 |
| 2 | Crop development | 22 Feb-27 March | 0.85 |
| 3 | Mid season | 28 March - 6 May | 1.00 |
| 4 | Late season | 7 May - 26 May | 0.55 |

The value of pan-coefficient was taken as 0.7. The water requirement for summer groundnut crop per unit area per day was calculated by using equation 3.3

$$Q = A \times E_{pan} \times K_p \times K_c \quad \text{---(3.3)}$$

In which,

Q - Quantity of water required per day, litres

A - Area of plot, m²

E_{pan}- Pan evaporation, mm/day

K_p - Pan coefficient

K_c - Crop coefficient

3.4.2 Water requirement of broad bed furrow irrigation treatments:

The amount of water required for each plot of broad bed furrow irrigation treatment was calculated by using equation 3.4

$$\frac{IW}{CPE} = 0.75 \quad \text{----- (3.4)}$$

In which, (Thosar *et al.*, 1992)

IW - Irrigation water, mm

CPE - cumulative pan evaporation, mm

Quantity of water required per plot in litres was calculated by using equation 3.5

$$Q = IW \times A \text{ -----} \quad \text{---(3.5)}$$

In which,

Q - Quantity of water delivered per plot, litres

IW - Net amount of water to be applied during irrigation, mm

A - Area of plot, m²

3.5 Agronomic practices :

3.5.1 Fertilizer application :

A basal dose of Nitrogen and Phosphate fertilizers was applied at the rate of 25 kg and 50 kg per hectare respectively through urea (N: 46 %) and diammonium phosphate (N: 18 %, P₂O₅ : 46 %). The complete dose of nitrogen and phosphate was applied at the time of sowing.

3.5.2 Weeding

Precaution was taken to keep the crop weed free. Two manual weedings were given and crop was kept clean. Before sowing Basalin 45 % fluchlorin selective weedicide was sprayed to eradicate weeds from the experimental field.

3.5.3 Earthing up

Earthing up was done manually after the formation of pegs, so that it can penetrate into a friable soil.

3.5.4 Harvesting and Drying of pods

The crop in the experimental plot was harvested treatmentwise after complete maturity of pods. The plants from the net plot were uprooted carefully and pods were plucked by manual labours on the same day in the field itself. Then the produce was filled in gunny bags treatmentwise, labelled properly and kept for sun drying on floor upto complete drying. The completely dried pods were weighed plotwise and weight was recorded as per treatments.

Table : 3.5 Schedule of Agronomic Practices

| Sr. No. | Date | Details |
|---------|--|------------------------|
| 1 | 2 nd February | Fertilizer application |
| 2 | 6 th , 7 th , 8 th March | Manual weeding |
| 3 | 11 th , 12 th , 13 th April | Manual weeding |
| 4 | 17 th , 18 th , 19 th April | Earthing up |
| 5 | 26 th May | Harvesting |

3.6 Soil moisture distribution and salt distribution pattern

Evaluation of moisture distribution pattern was necessary to find out amount of irrigation water that was infiltrated into and percolated through the soil mass around the root spread of the crop. To evaluate the soil moisture distribution pattern, the soil samples were collected by screw auger immediately after 24 hour of irrigation and soil moisture content were determined by gravimetric system on dry weight basis.

To determine salt distribution pattern the soil samples were collected at different depth and their electrical conductivity (EC) and pH were determined to evaluate salt concentration at various depths affected by different irrigation treatment.

In case of Drip and Drip inline irrigation system, soil samples were taken at point source and at 10 cm interval from point source along the lateral and across the lateral upto a depth of 30 cm at an interval of 10 cm.

In case of microsprinkler irrigation the soil samples were taken diagonally along the lateral with an interval of 50 cm including point source of microsprinkler irrigation upto a depth of 30 cm at an interval of 10 cm. In case of

BBF irrigation, the soil samples were taken laterally at the interval of 15 cm from the centre furrow to the middle of bed up to depth of 30 cm at an interval of 10 cm.

3.7 Irrigation Efficiency

Irrigation efficiencies were calculated by taking the observations of moist samples immediately after 24 hours of irrigation. The moisture content of these soil samples were calculated by gravimetric system on dry weight basis for bbf irrigation.

3.7.1 Application Efficiency

Water application efficiency is the ratio of water stored in the rootzone of the plant to the water delivered at the field supply channel.

The application efficiency for Drip, Drip inline, and Microsprinkler irrigation system was calculated by using equation 3.6 (a)

$$E_a = \frac{e \times q_{min} \times T}{V} \times 100 \quad \text{-----3.6 (a)}$$

In which,

E_a - Application efficiency, per cent

e - Total number of outlets in each plot

q_{min} - Minimum discharge rate of each outlet, lit/hour.

T - Total irrigation time, hours

V - Total volume of water applied, lit.

While, in case of broad bed furrow irrigation, the application efficiency was calculated by using equation 3.6 (b)

$$E_a = \frac{W_s}{W_f} \times 100 \quad \text{-----3.6 (b)}$$

In which,

E_a - Application efficiency, per cent

W_s - Water stored in the rootzone of crop, lit

W_f - Water delivered to the field, lit.

3.8.2 Distribution Efficiency (Uniformity coefficient)

The distribution efficiency can be expressed in terms of uniformity coefficient, Uniformity coefficient was calculated by measuring the discharge rates of each outlet for a period of five minute duration by using equation 3.7 a for drip, drip inline, and microsprinkler irrigation system.

$$C_u = \left(1 - \frac{\sum x}{mn} \right) \times 100 \quad \text{---3.7 (a)}$$

In which,

m - average volume of all observation, ml.

n - Total number of observations.

x - Numerical deviation of individual observation from the average rate,

The distribution efficiency in case of broad bed furrow irrigation system was calculated by using equation 3.7 (b)

$$E_d = \left(1 - \frac{\bar{Y}}{d} \right) \times 100 \quad \text{---3.7 (b)}$$

In which,

Y - Average of absolute values of the deviation in depth of water stored from the average depth of water stored, cm.

d - Average depth of water stored, cm

3.7.3 Irrigation and field water use efficiency

Irrigation water use efficiency is the ratio of crop yield to the amount of irrigation water applied in the field. It was calculated by using equation 3.8 (a)

$$E_{ui} = \frac{Y}{WR} \quad \text{...3.8 (a)}$$

Field water use efficiency is the ratio of crop yield to the amount of irrigation water applied in the field plus useful rainfall during growth period of crop.

$$Euf = \frac{Y}{WR + UR}$$

In which,

Eui - Irrigation water use efficiency, q/ha-cm

Euf - Field water use efficiency, q/ha-cm

Y - Crop yield, q

UR - Effective rainfall during growth period, ha- cm

WR - Water requirement, ha- cm.

3.8 Biometrics observations

For biometrics observations five plants in the net plot from each treatment were selected at random and labelled for recording various observations. The observations from each plot were recorded periodically at fortnightly interval starting from date of sowings.

3.8.1 Germination count

Germination count was taken for each hill throughout the field. It gave germination rate, percentage of germination and period of germination in different treatments. The total number of seedlings emerged per net plot was counted.

3.8.2 Growth studies

3.8.2.1 Height of plant

Height of five selected plant was measured (cm) from the base of the shoot to the end of the last opened apex leaf of the main shoot. The average was calculated and expressed as height/plant.

3.8.2.2 Number of leaves

The plant already selected for plant height observation was taken for counting number of leaves per plant.

3.8.2.3 Dry matter per plant

Dry matter indicates the growth and vigour of the plant. For dry matter study one plant from each net plot was randomly sampled. The shoot portion of the plant was separated out from the root and air dried. The samples were then oven dried at 65^o C for 24-48 hours till the weight was constant. The weight was expressed in grams as dry matter production per plant.

3.8.2.4 Leaf area per plant

The plants which were sampled for dry matter study were also used for determination of leaf area. The functional leaflets were separated carefully from the sampled plant and classified into different size classes. The maximum length and breadth of a representative leaf from each size group was recorded. Thus the leaf area of leaves in the individual group of leaves was calculated by following formula.

Leaf area of plant = Maximum length x Maximum breadth x 0.70 x No. of leaves

K factor = 0.70 (Padalia and Patel, 1980)

3.8.3 Yield studies

3.8.3.1 Number of pods per plant

At harvest, the total number of pods was counted on five sample plants. The pod number was grouped into two category viz. developed and undeveloped pods. The average value was expressed as developed and undeveloped pods per plant.

3.8.3.2 Weight of pods per plant

After harvest the pod yield per plant was calculated by recording weight of dry pods per plant from the observation plants.

3.8.3.3 Pod yield per hectare

The produce of each net plot was cleaned and sundried. On complete drying, the weight of dry pods per net plot was recorded and expressed as yield in q/ha.

3.8.3.4 Haulm yield per hectare

The haulm from each plot were sundried for 5 days after harvest, tied in bundles and the weight was recorded treatmentwise as haulm yield per plot. The haulm yield per ha was calculated from the yield per plot.

3.8.4 Quality studies

3.8.4.1 Shelling percentage

Dried pods weighing 500 g were taken from the produce of each plot. The pods were shelled manually, kernel and pod shell were separated. Kernel weight was recorded and shelling percentage was calculated by using following formula.

$$\text{Shelling percentage} = \frac{\text{Kernel weight}}{\text{Pod weight}} \times 100$$

3.8.4.2 Test weight

From dried kernels obtained after shelling 100 kernels were counted and weighed to get test weight.

3.8.4.3 Oil content

A composite sample of kernels from each treatment was taken and oil content was estimated by the Pulsed nuclear magnetic resonance (NMR) apparatus.

3.9 Cost Economics

Cost economics of all treatments was worked out to compare the net returns and benefit cost ratio. For this purpose the life period of polyvenyl chloride items was considered as ten years and for rests of G. I. items and motor pump set as 25 years. Standard market rates were taken for each items. One hectare area under each treatment was considered for comparison. Fixed cost, operating cost, total cost, net return and benefit cost ratio for each system were worked out as follows.

3.9.1 Fixed cost

Fixed cost comprised of interest on initial cost and depreciation on the system. The interest calculated on the capital was at the rate of 10 per cent annum.

The depreciation on the system was worked out by straight line method given below-

$$D = \frac{I - S}{L}$$

In which,

D - Depreciation per annum

I - Initial cost of system

S - Salvage value (0.1 I)

L - Expected life period of the system.

3.9.2 Operating cost

Operating cost is the amount which is actually paid by the cultivator in cash throughout cultivation period. Total operating cost comprised of operating cost of the system and interest on operating cost at the rate of twelve per cent per annum.

3.9.3 Total cost

Total cost comprised of fixed cost plus operating cost. Total cost /ha was calculated for comparison on per ha basis.

3.9.4 Net benefit and cost benefit ratio

Net benefit was obtained by subtracting the total cost from gross return. Benefit Cost ratio was calculated by dividing the net return by total cost.

CHAPTER IV

RESULTS AND DISCUSSION

An experiment was conducted on summer groundnut (*Arachis hypogaea* L.) Cv. TAG-24 for comparison of different irrigation systems like drip, microsprinkler, drip inline and broad bed furrow, (BBF) to select the most economical system.

Data were collected in the field to compare water requirement of crop and soil moisture distribution pattern in soil profile upto effective crop rootzone for different irrigation treatments. The water requirement of summer groundnut was worked out on the basis of previous day evaporation data. The data in respect of growth of plants, yield and quality were collected. Data were analysed and results obtained are discussed in this chapter. Lastly, cost economics is worked out.

4.1 Crop water Requirement

The estimation of the water requirement of crop is one of the basic needs for crop planning on the farm. Unless, this is given proper consideration, it results in poor crops growth. Crop water requirement varies with the kind of crop, degree of maturity, water availability and atmospheric conditions such as humidity, wind velocity, sunshine hours, and temperature.

4.1.1 Evapotranspiration of summer Groundnut (ETc)

The daily climatological data recorded from meteorological observatory, Department of Agronomy Dr. P.D.K.V., Akola, during the period from 2nd February 2000 to 26th May 2000 are presented in appendix. A. From this data, evapotranspiration of summer groundnut was calculated by open pan evaporation using equation 3.3, considering pan coefficient as 0.7 throughout the growth period.

The selected values of crop coefficient for different growth stages are presented in Table 3.4. The estimated values of crop evapotranspiration are given in Table 4.1.

Broad bed furrow irrigation treatments irrigated at the rate of IW/CPE ratio of 0.75 when cumulative pan evaporation reached to 40 mm. During the crop growth period rainfall of 25.2 mm occurred on date 23rd February, Hence considering effective rainfall and water holding capacity of soil the micro irrigation was delayed for requirement of 115 litres of water per plot; similarly for broad bed furrow irrigation treatments irrigation was delayed by 6 days and were irrigated as usual when CPE reached to 40 mm.

4.1.2 Amount of water applied to summer groundnut crop

After dibbling of kernels, the first irrigation was given on 2nd February 2000 to all the treatments to maintain the soil moisture upto field capacity. There after the crop was irrigated daily by drip microsprinkler, drip inline irrigation treatments and broad bed furrow irrigation treatments @ IW/CPE ratio of 0.75 in cumulative pan evaporation reached to 40 mm. The amount of water applied to summer groundnut crop under drip, microsprinkler, dripinline and BBF irrigation treatments are presented in table 4.1

From Table 4.1 it is observed that the amount of water applied through drip, microsprinkler and drip inline was 70.61 ha- cm which was 80.44 per cent of broad bed furrow irrigation (87.77 ha-cm)

The requirement of water on hectare basis and its saving compared to broad bed furrow system and further incremental area due to irrigation by water equivalent to the amount of broad bed furrow treatment are shown in Table 4.2

Table 4.1 Evapotranspiration and water applied

| Months and Dates | Open pan evaporation (mm) | Crop Coefficient | Evapotranspiration, ETc (mm) | water applied per plot, litres (Same amount of water applied) | |
|------------------|---------------------------|------------------|------------------------------|---|------|
| | | | | T1/ T2/ T3 | T4 |
| Feb, 2000 | | | | | |
| 2 | | Dibbling | - | 306* | 306* |
| 3 | 5.0 | 0.45 | 1.575 | 12.75 | |
| 4 | 5.2 | 0.45 | 1.638 | 13.26 | |
| 5 | 4.6 | 0.45 | 1.449 | 11.73 | |
| 6 | 6.0 | 0.45 | 1.890 | 15.30 | |
| 7 | 5.2 | 0.45 | 1.638 | 13.26 | |
| 8 | 4.6 | 0.45 | 1.449 | 11.73 | |
| 9 | 3.9 | 0.45 | 1.228 | 9.94 | 243 |
| 10 | 4.9 | 0.45 | 1.543 | 12.49 | |
| 11 | 6.0 | 0.45 | 1.890 | 15.30 | |
| 12 | 7.8 | 0.45 | 2.457 | 19.90 | |
| 13 | 4.8 | 0.45 | 1.512 | 12.24 | |
| 14 | 5.3 | 0.45 | 1.669 | 13.51 | |
| 15 | 5.6 | 0.45 | 1.764 | 14.28 | |
| 16 | 4.6 | 0.45 | 1.449 | 11.73 | |
| 17 | 6.4 | 0.45 | 2.016 | 16.32 | 243 |
| 18 | 6.8 | 0.45 | 2.142 | 17.35 | |
| 19 | 6.0 | 0.45 | 1.890 | 15.30 | |
| 20 | 7.0 | 0.45 | 2.205 | 17.86 | |
| 21 | 5.0 | 0.45 | 1.575 | 12.75 | |
| 22 | 5.4 | 0.85 | 3.213 | 26.02 | |
| 23 | 6.4 | 0.85 | 3.808 | --- | |
| 24 | 3.2 | 0.85 | 1.904 | --- | |
| 25 | 3.2 | 0.85 | 1.904 | ---- | |
| 26 | 3.0 | 0.85 | 1.785 | ---- | |
| 27 | 3.4 | 0.85 | 2.023 | ---- | |
| 28 | 4.8 | 0.85 | 2.856 | ---- | |
| 29 | 7.0 | 0.85 | 4.165 | 33.73 | 243 |

(Table 4.1 contd.)

326.75

729

(Table 4.1 contd)

| Months and Dates | Open pan evaporation (mm) | Crop Coefficient | Evapotranspiration, ETc (mm) | Water applied per plot, litres (Same amount of water applied) | |
|--------------------|---------------------------|------------------|------------------------------|---|-------------|
| | | | | T1/ T2/ T3 | T4 |
| March, 2000 | | | | | |
| 1 | 5.6 | 0.85 | 3.332 | 26.98 | |
| 2 | 6.8 | 0.85 | 4.046 | 32.77 | |
| 3 | 10.0 | 0.85 | 5.950 | 48.19 | |
| 4 | 10.3 | 0.85 | 6.128 | 49.63 | |
| 5 | 8.8 | 0.85 | 5.236 | 42.41 | 243 |
| 6 | 7.6 | 0.85 | 4.522 | 36.62 | |
| 7 | 7.6 | 0.85 | 4.522 | 36.62 | |
| 8 | 8.4 | 0.85 | 4.998 | 40.48 | |
| 9 | 9.2 | 0.85 | 5.474 | 44.33 | |
| 10 | 8.4 | 0.85 | 4.998 | 40.48 | 243 |
| 11 | 9.0 | 0.85 | 5.355 | 43.77 | |
| 12 | 10.2 | 0.85 | 6.069 | 49.15 | |
| 13 | 12.4 | 0.85 | 7.378 | 59.76 | |
| 14 | 9.4 | 0.85 | 5.593 | 45.30 | 243 |
| 15 | 9.1 | 0.85 | 5.414 | 43.85 | |
| 16 | 8.0 | 0.85 | 4.760 | 38.55 | |
| 17 | 8.4 | 0.85 | 4.998 | 40.48 | |
| 18 | 9.0 | 0.85 | 5.355 | 43.37 | |
| 19 | 11.2 | 0.85 | 6.664 | 53.97 | 243 |
| 20 | 8.4 | 0.85 | 4.998 | 40.48 | |
| 21 | 8.6 | 0.85 | 5.117 | 41.44 | |
| 22 | 9.4 | 0.85 | 5.593 | 45.30 | |
| 23 | 10.2 | 0.85 | 6.069 | 49.15 | 243 |
| 24 | 8.6 | 0.85 | 5.117 | 41.44 | |
| 25 | 10.9 | 0.85 | 6.485 | 52.52 | |
| 26 | 10.8 | 0.85 | 6.426 | 52.05 | |
| 27 | 9.8 | 0.85 | 5.831 | 47.23 | 243 |
| 28 | 7.4 | 0.85 | 5.180 | 41.95 | |
| 29 | 9.8 | 0.85 | 6.860 | 55.56 | |
| 30 | 10.3 | 0.85 | 7.210 | 58.40 | |
| 31 | 11.6 | 0.85 | 8.120 | 65.77 | 243 |
| | | | | 1407.6 | 1701 |

(Table 4.1 contd)

(Table 4.1 contd)

| Months and Dates | Open pan evaporation (mm) | Crop Coefficient | Evapotranspiration, ETe (mm) | water applied per plot, litres (Same amount of water applied) | |
|--------------------|---------------------------|------------------|------------------------------|---|-------------|
| | | | | T1/ T2/ T3 | T4 |
| April, 2000 | | | | | |
| 1 | 106 | 1.00 | 7.420 | 60.10 | |
| 2 | 10.1 | 1.00 | 7.070 | 57.26 | |
| 3 | 9.0 | 1.00 | 6.300 | 51.03 | 243 |
| 4 | 11.2 | 1.00 | 7.840 | 63.50 | |
| 5 | 11.2 | 1.00 | 7.840 | 63.50 | |
| 6 | 11.4 | 1.00 | 7.980 | 64.63 | |
| 7 | 12.4 | 1.00 | 8.680 | 70.30 | 243 |
| 8 | 10.4 | 1.00 | 7.280 | 58.96 | |
| 9 | 12.6 | 1.00 | 8.820 | 71.44 | |
| 10 | 15.2 | 1.00 | 10.64 | 86.18 | 243 |
| 11 | 11.6 | 1.00 | 8.120 | 65.77 | |
| 12 | 10.0 | 1.00 | 7.000 | 56.70 | |
| 13 | 11.3 | 1.00 | 7.910 | 64.07 | |
| 14 | 11.5 | 1.00 | 8.050 | 65.20 | 243 |
| 15 | 15.1 | 1.00 | 10.570 | 85.61 | |
| 16 | 12.6 | 1.00 | 8.820 | 71.44 | |
| 17 | 13.7 | 1.00 | 9.590 | 77.67 | 243 |
| 18 | 13.2 | 1.00 | 9.24 | 74.84 | |
| 19 | 13.4 | 1.00 | 9.38 | 75.97 | |
| 20 | 12.4 | 1.00 | 8.68 | 70.30 | 243 |
| 21 | 13.4 | 1.00 | 9.38 | 75.97 | |
| 22 | 11.5 | 1.00 | 8.050 | 65.20 | |
| 23 | 11.0 | 1.00 | 7.700 | 62.37 | 243 |
| 24 | 16.0 | 1.00 | 11.200 | 90.72 | |
| 25 | 19.6 | 1.00 | 13.720 | 111.13 | 243 |
| 26 | 20.0 | 1.00 | 14.000 | 113.4 | |
| 27 | 19.4 | 1.00 | 13.580 | 109.99 | 243 |
| 28 | 19.0 | 1.00 | 13.300 | 107.10 | |
| 29 | 20.3 | 1.00 | 14.210 | 115.10 | 243 |
| 30 | 17.2 | 1.00 | 12.040 | 97.52 | |
| | | | | 2303.6 | 2430 |

(Table 4.1 contd.)

(Table 4.1 contd.)

| Months and Dates | Open pan evaporation (mm) | Crop Coefficient | Evapotranspiration, E _{Tc} (mm) | Water applied per plot, litres (Same amount of water applied) | |
|--|---------------------------|------------------|--|---|--------------------|
| | | | | T1/ T2/ T3 | T4 |
| May, 2000 | | | | | |
| 1 | 17.6 | 1.00 | 12.320 | 99.79 | 243 |
| 2 | 16.4 | 1.00 | 11.480 | 92.98 | |
| 3 | 16.0 | 1.00 | 11.200 | 90.72 | |
| 4 | 18.8 | 1.00 | 13.160 | 106.59 | 243 |
| 5 | 15.0 | 1.00 | 10.500 | 85.05 | |
| 6 | 15.8 | 1.00 | 11.060 | 89.58 | |
| 7 | 13.8 | 0.55 | 5.313 | 43.03 | 243 |
| 8 | 7.8 | 0.55 | 3.003 | 24.32 | |
| 9 | 10.0 | 0.55 | 3.850 | 31.18 | |
| 10 | 12.0 | 0.55 | 4.620 | 37.42 | |
| 11 | 12.6 | 0.55 | 4.851 | 39.29 | 243 |
| 12 | 14.8 | 0.55 | 5.698 | 46.15 | |
| 13 | 15.0 | 0.55 | 5.775 | 46.77 | |
| 14 | 15.8 | 0.55 | 6.083 | 49.27 | 243 |
| 15 | 14.4 | 0.55 | 5.544 | 44.90 | |
| 16 | 17.0 | 0.55 | 6.545 | 53.01 | |
| 17 | 15.0 | 0.55 | 5.775 | 46.77 | 243 |
| 18 | 15.4 | 0.55 | 5.929 | 48.02 | |
| 19 | 10.3 | 0.55 | 3.965 | 32.11 | |
| 20 | 5.0 | 0.55 | 1.925 | 15.59 | |
| 21 | 6.2 | 0.55 | 2.387 | 19.33 | 243 |
| 22 | 12.6 | 0.55 | 4.851 | 39.29 | |
| 23 | 12.6 | 0.55 | 4.851 | 39.29 | |
| 24 | 15.5 | 0.55 | 5.967 | 48.33 | 243 |
| 25 | 17.3 | 0.55 | 6.660 | 53.94 | |
| 26** | 17.0 | 0.55 | 6.545 | 53.01 | |
| | | | 699.481 | 1375.73 | 1944 |
| Amount of water applied per plot; litres Amount of water applied, ha-cm | | | | 5719.68 (70.61) | 7110.00 (87.77) |

*First irrigation up to field capacity after dibbling

** Irrigation was stopped after 26 th May 2000

Table 4.2 Comparative statement of water utilization

| Treatment | Water applied (ha-cm) | Water saving (%) | Area would be irrigated by applying water equivalent to BBF (ha) | Percent increase in area over BBF |
|-------------------|-----------------------|------------------|--|-----------------------------------|
| (T ₁) | 70.61 | 19.55 | 1.24 | 24.30 |
| (T ₂) | 70.61 | 19.55 | 1.24 | 24.30 |
| (T ₃) | 70.61 | 19.55 | 1.24 | 24.30 |
| (T ₄) | 87.77 | 00 | 1.00 | - |

Table 4.2 indicated that the water saving of 19.55 per cent was achieved through drip, microsprinkler and drip inline system due to their higher irrigation efficiencies over broad bed furrow system of irrigation. It also indicated that by utilizing water equivalent to broad bed furrow irrigation system (87.77 ha-cm), the per cent increase in irrigation by adopting micro-irrigation systems would be 24.30 per cent i.e. 1.24 times over broad bed furrow system. This shows the major advantage of micro-irrigation over broad bed furrow system of irrigation.

4.2 Irrigation requirement

The amount of water applied to each plot by drip; microsprinkler; drip inline and BBF irrigation system on monthly basis and different crop stages growth are presented in table 4.3 and 4.4 respectively.

The fig. 4.1 and 4.2 show the amount of water used during different months and growth stages of groundnut crop under all treatment studied.

Table 4.3 Monthly requirement of water to summer groundnut crop through different treatments of irrigation system.

| Month 2000 | Water applied per plot per month, litres. | |
|----------------------|---|--------------------|
| | T1 / T2 / T3 | T4 |
| 2 nd Feb* | 306.00* (3.77) | 306.00 (3.77) |
| Feb** | 326.75 (4.04) | 729.00 (9.00) |
| March | 1407.60 (17.38) | 1701.00 (21.00) |
| April | 2303.60 (28.44) | 2430.00 (30.00) |
| May*** | 1375.73 (16.98) | 1944.00 (24.00) |
| Total, lits /plot | 5719.68 (70.61) | 7110.00 (87.77) |

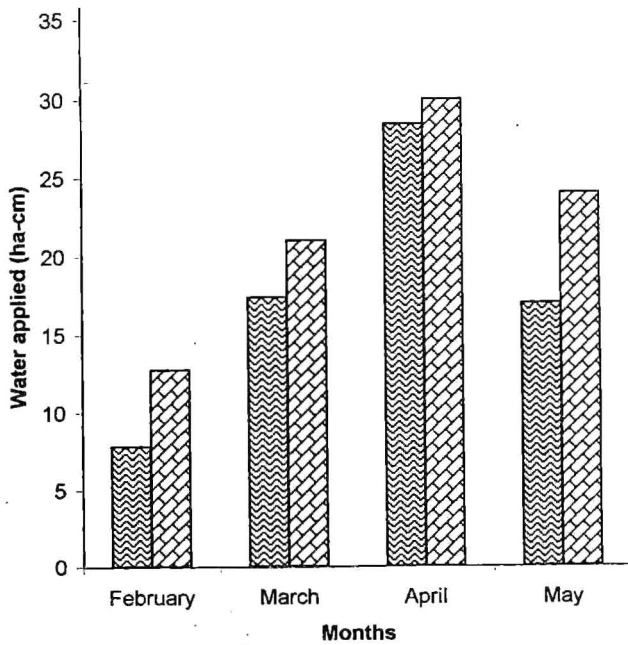
Figures in parenthesis indicate ha-cm.

*Soil moisture was brought up to field capacity by applying irrigation

**Daily Micro-irrigation was started on 3rd February 2000.

*** Irrigation was stopped after 26th May 2000.

From the Table 4.3, it is observed that the monthly cumulative amount of water applied to all treatments was increased during growth period in each successive month. Water requirement of summer groundnut crop was maximum in the month of April 2000 followed by March, May and February respectively. This is due to the higher pan evaporation values and peak growth stages of crop. Hence the farmers should have assured irrigation water resources in these months.



■ micro irrigation (T1/T2/T3)
 ▨ Broad bed furrow (T4)

Fig 4.1 : Monthly water requirement to summer groundnut through different irrigation treatments

Table 4.4 Water applied to summer groundnut crop during different growth stages.

| Growth stage and period, 2000 | Water applied per plot, litres | |
|---|--|-------------------------------|
| | Drip, Microsprinkler Drip inline | BBF |
| Dibbling* | 306.00* (3.77) | 306.00 * (3.77) |
| 1. Initial stage (2 Feb - 21 Feb) | 267.00 (3.30) | 486.00 (6.00) |
| 2. Crop development stage (22 Feb - 27 March) | 1245.67 (15.38) | 17.01.00 (21.00) |
| 3. Mid season stage (28 March – 6 May) | 3089.99 (38.15) | 3159.00 (39.00) |
| 4. Late season stage (7 May - 26 May) | 811.02 (10.01) | 1458.00 (18.00) |
| Total | 5719.68 (70.61) | 7110 (87.77) |

* First irrigation up to field capacity to all treatments

Figure in parenthesis indicate ha- cm.

From Table 4.4, it is observed that the amount of water applied was increased from initial stage to mid season stage and it was decreased during the late season stage. The water requirement in the initial stage may be less due to less foliage area covered by the plant and low temperature. Further, as the crop developed, area covered by foliage of plant was increased. The evaporation was also more during this period due to increase in temperature. During late season stage, the water requirement was reduced.

From Table 4.4, it is obvious that the crop requires maximum amount of water till the completion of mid season stage. Particularly mid-season stage is most susceptible to water stress followed by crop development stage during the full pegging and pod development of groundnut. Results corroborate the results reported by Katri and Patel (1983)

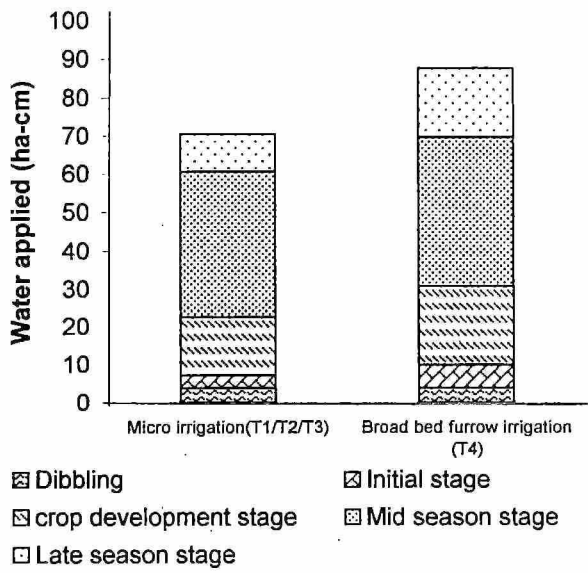


Fig 4.2 : Amount of water applied to summer groundnut during different growth stages



Plate 4.1 Application of water to summer groundnut through drip irrigation system



Plate 4.2 Application of water to summer groundnut through microsprinkler irrigation system



Plate 4 3 Application of water to summer groundnut through drip inline irrigation system



Plate 4 4 Broad bed furrow irrigation system

Plate 4 1, 4 2, 4.3 and 4 4 shows the application of water through different irrigation system to summer groundnut

4.3 Soil moisture distribution

The moisture distribution in soil under diferent irrigation systems were studied in this investigation to evaluate the vertical and lateral uniformity of water spread in the crop root zone. Considering the rooting habits of crop and maximum expected root depth, the soil moisture samples were collected as per the procedure laid out in article 3 6 and the data are presented in table 4.5. The soil moisture countours were plotted and are presented diagrammatically in fig. 4.3, 4.4, 4 5 and 4.6.

Table 4.5 A Soil moisture profile under drip irrigation system

| Vertical depth from soil surface, cm | Moisture, Per cent | | | | | | | |
|--------------------------------------|---------------------------------------|-------|-------|-------|--|-------|-------|-------|
| | Horizontal distance along lateral, cm | | | | Horizontal distance across lateral, cm | | | |
| | 0 | 20 | 40 | 60 | 0 | 20 | 40 | 60 |
| 0 | 32.00 | 31.00 | 30.00 | 32.50 | 32.40 | 31.30 | 31.50 | 32.70 |
| 10 | 31.60 | 30.00 | 29.70 | 31.20 | 31.40 | 30.70 | 31.10 | 30.40 |
| 20 | 30.0 | 29.50 | 28.70 | 29.60 | 30.30 | 28.60 | 27.80 | 30.10 |
| 30 | 29.70 | 28.70 | 28.10 | 28.30 | 29.50 | 27.40 | 27.30 | 28.60 |

Table 4.5 B Soil moisture profile obtained under microsprinkler irrigation system

| Vertical depth from soil surface, cm | Moisture, per cent | | | | | | |
|--------------------------------------|--|-------|-------|-------|-------|-------|-------|
| | Spot position as shown in fig. 4.4 (a) | | | | | | |
| | A | B | C | D | E | F | G |
| 0 | 30.50 | 31.40 | 31.20 | 32.20 | 32.80 | 32.50 | 32.40 |
| 10 | 28.00 | 28.30 | 31.60 | 32.40 | 32.60 | 32.00 | 31.20 |
| 20 | 28.30 | 28.60 | 30.80 | 31.40 | 32.40 | 31.00 | 30.00 |
| 30 | 26.20 | 26.70 | 28.90 | 28.90 | 29.60 | 29.10 | 28.50 |

C and G indicates point source position .

Table 4.5 (C) Soil moisture profile obtained under Drip inline irrigation system

| Vertical depth from soil surface, cm | Moisture, Per cent | | | | | | | |
|--------------------------------------|---------------------------------------|-------|-------|-------|--|-------|-------|-------|
| | Horizontal distance along lateral, cm | | | | Horizontal distance across lateral, cm | | | |
| | 0 | 20 | 40 | 60 | 0 | 20 | 40 | 60 |
| 0 | 32.40 | 32.00 | 31.51 | 31.90 | 32.70 | 32.20 | 32.40 | 32.90 |
| 10 | 31.80 | 32.80 | 32.60 | 31.70 | 32.50 | 32.30 | 31.90 | 32.60 |
| 20 | 31.20 | 30.30 | 30.70 | 31.10 | 31.70 | 30.60 | 30.90 | 32.40 |
| 30 | 30.50 | 29.40 | 29.60 | 30.20 | 30.50 | 29.40 | 29.50 | 30.90 |

Table 4.5 D Soil moisture profile obtained under BBF irrigation system

| | |
|-------------------------|-------------------------|
| Volume of water applied | = 30 lit/m ² |
| Wetted area | = 100 per cent |
| field capacity | = 32 % |

| Vertical depth from soil surface cm | Moisture, per cent | | | | |
|-------------------------------------|-----------------------------|-------|-------|-------|-------|
| | Lateral distance on bed, cm | | | | |
| | 15 | 30 | 45 | 60 | 75 |
| 0 | 29.30 | 28.40 | 27.80 | 28.40 | 29.50 |
| 10 | 30.40 | 29.70 | 28.30 | 29.50 | 30.50 |
| 20 | 31.60 | 30.20 | 29.40 | 30.40 | 31.70 |
| 30 | 32.30 | 31.50 | 30.60 | 31.20 | 32.40 |

Fig 4.3 (a) Shows the sampling positions of drip irrigation treatment (T₁) and fig. 4.3 (b) and (c) show the moisture distribution observed along the lateral and across the lateral. It shows that moisture content was found closer to field capacity below the point source and also between two point sources and across lateral in the rootzone (22 cm depth). Also even distribution of moisture was found at 10-20 cm depth, which shows the favourable situation of moisture distribution in the rootzone of crop. This provides the favourable environment for full pegging and pod development. The results correspond to those obtained by Swaminathan (1972).

Fig 4.4 (a) Shows the sampling position of microsprinkler irrigation treatment (T₂) and fig 4.4 (b) shows the soil moisture distribution between two microsprinkler and along the line of lateral in plot. It shows that the moisture content was very close to field capacity in the rootzone of crop except at the remote corners

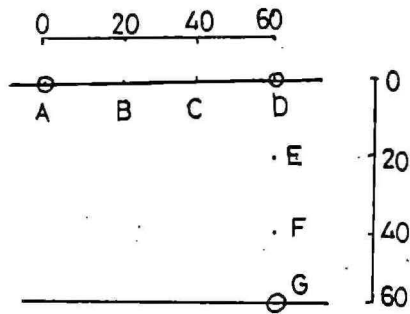


Fig 4.3 (a) Sampling positions

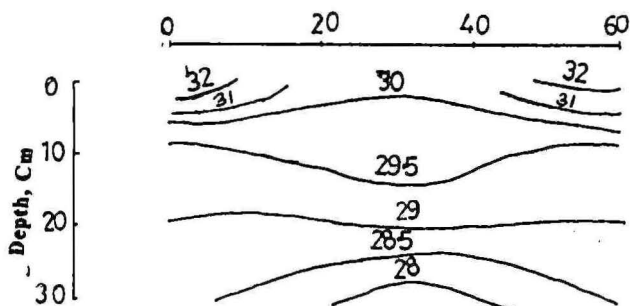


Fig 4.3 (b) Along lateral

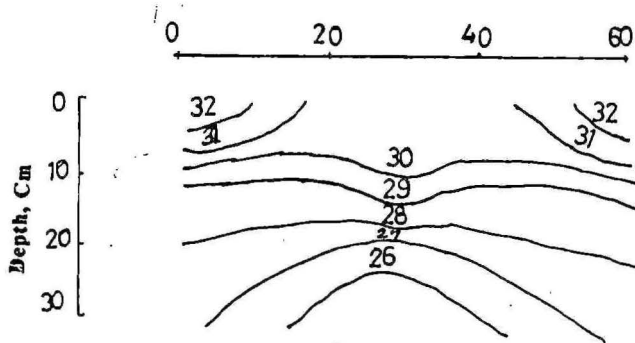


Fig 4.3 (c) Across lateral

Fig 4.3 Soil moisture distribution observed under drip irrigation system.

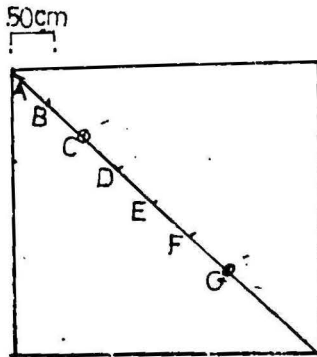


Fig. 4.4 (a) Sampling position.

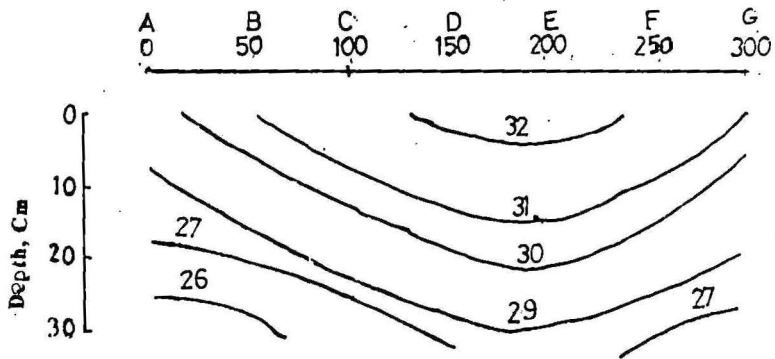


Fig. 4.4 Soil moisture distribution observed under microsprinkler irrigation system.

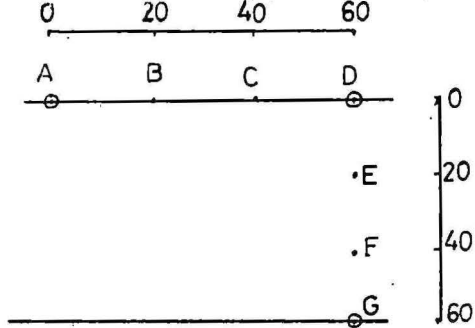


Fig 4.5 (a) Sampling positions

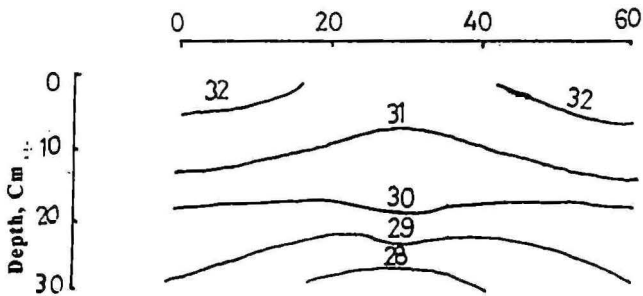


Fig 4.5 (b) Along lateral

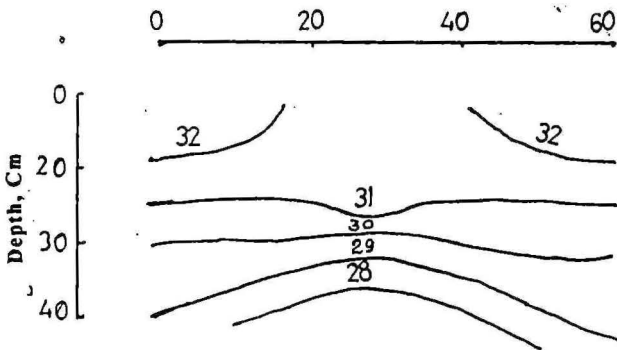


Fig 4.5 (c) Across lateral

Fig 4.5 Soil moisture distribution observed under drip irrigation system.

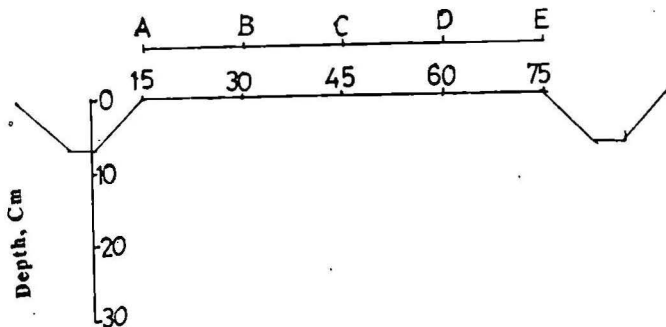


Fig 4.6 (a) Sampling positions.

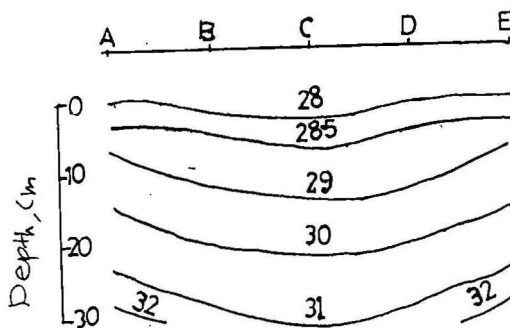


Fig 4.6 Soil moisture distribution observed under Broad bed furrow irrigation system.

of the plot. That provides the favourable environment for germination, full pegging and pod development. Moisture profile shows higher percentage of moisture content between two microsprinklers.

Fig. 4.5 (a) Shows the sampling positions of drip inline irrigation treatments (T₃) and fig 4.5 (b) and (c) shows the moisture distribution along the lateral and across the lateral respectively. It shows similar moisture profile like drip irrigation treatment with moisture content closer to field capacity in the rootzone of crop.

Fig. 4.6 Show the moisture contours obtained in broad bed furrows. The distance between centre of consecutive furrows were 90 cm, however, due to dense covering of bed area by canopy, the evaporation loss was checked to the maximum extent and hence in the centre of two furrow, the moisture content was observed about 28 - 30 per cent which was close to field capacity . From the Table 4.5(d) it is observed that adequate moisture status was maintained in BBF irrigation system in vertical and horizontal direction.

4.4 Salt distribution

The salt distribution in different irrigation treatments under investigation, are presented in Table 4.6 A, 4.6B, 4.6C, and 4.6D.

Table 4.6 A. Electrical conductivity profile under drip irrigation system

| Vertical depth from surface, (cm) | Electrical conductivity dS/m | | | |
|-----------------------------------|--|------|------|------|
| | Sampling position as shown in fig. 4.7 a | | | |
| | A | B | C | D |
| 0 | 0.45 | 1.48 | 1.52 | 0.51 |
| 10 | 0.38 | 0.68 | 0.75 | 0.44 |
| 20 | 0.29 | 0.43 | 0.44 | 0.37 |
| 30 | 0.21 | 0.32 | 0.33 | 0.23 |

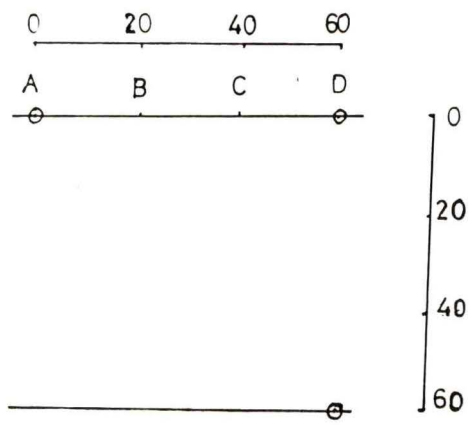


Fig 4.7 (a) Sampling positions.

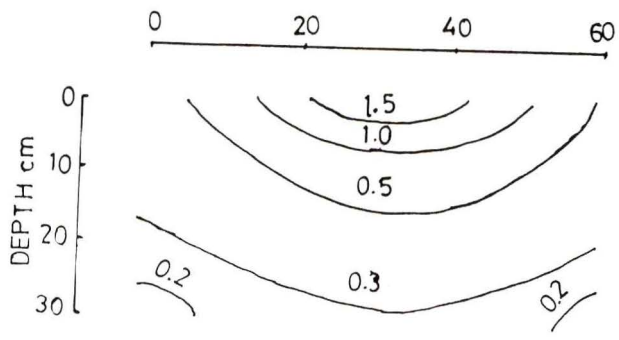


Fig 4.7 Electrical conductivity observed under drip irrigation system. Depth, Cm



From Table 4.6 A and Fig. 4.7, it can be seen that in case of drip irrigation electrical conductivity was in the range of 0.21 to 1.52 dS/m.

Salinity in the area under point source was lowest due to constant flushing action while the salt concentration increased towards the outer periphery edge of the wetted zone and was in the range of 1.48 to 1.52 dS/m (EC)

Table 4.6 B. Electrical conductivity profile under microsprinkler irrigation system.

| Vertical depth from surface, (cm) | Electrical conductivity dS/m | | | | |
|-----------------------------------|---|------|------|------|------|
| | Sampling position as shown in fig 4.8 a | | | | |
| | C | D | E | F | G |
| 0 | 0.31 | 0.24 | 0.21 | 0.26 | 0.29 |
| 10 | 0.33 | 0.30 | 0.28 | 0.31 | 0.32 |
| 20 | 0.37 | 0.41 | 0.46 | 0.37 | 0.33 |
| 30 | 0.19 | 0.15 | 0.19 | 0.16 | 0.19 |

In case of Microsprinkler irrigation treatment lower salt concentration was found between two microsprinklers and increases with depth till 20 cm. This may be due to leaching of salts, further it declines because of low moisture penetration in the zone. The results were depicted in fig. 4.8

Table 4.6 C. Electrical conductivity profile under drip inline irrigation system.

| Vertical depth from surface, (cm) | Electrical conductivity dS/m | | | |
|-----------------------------------|--|------|------|------|
| | Sampling position as shown in fig. 4.9 A | | | |
| | A | B | C | D |
| 0 | 0.38 | 1.42 | 1.46 | 0.44 |
| 10 | 0.37 | 0.67 | 0.55 | 0.39 |
| 20 | 0.36 | 0.46 | 0.45 | 0.26 |
| 30 | 0.24 | 0.34 | 0.49 | 0.22 |

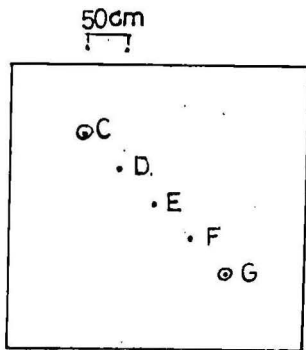


Fig 4.8 (a) Sampling positions.

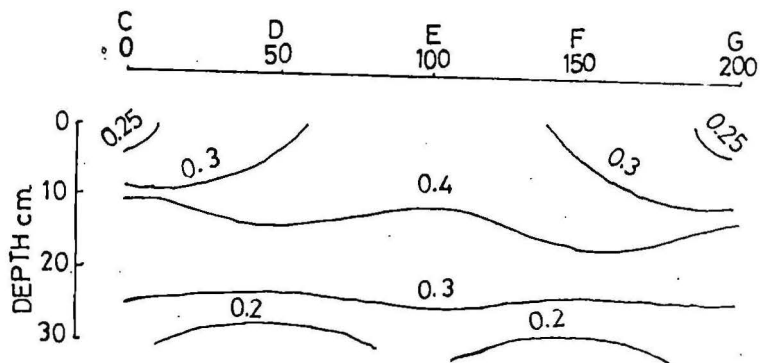


Fig 4.8 Electrical conductivity observed under microsprinkler irrigation system.

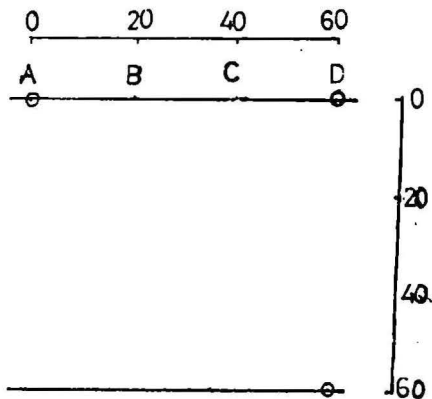


Fig 4.9 (a) Sampling positions.

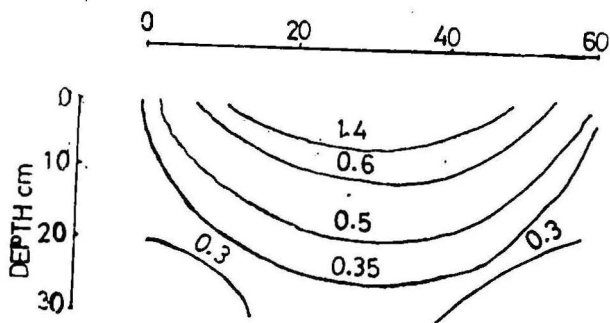


Fig 4.9 Electrical conductivity observed under drip in-line irrigation system.

Similar results were obtained in drip inline irrigation system as shown in fig. 4.9 and Table 4.6, C. Electrical conductivity was in the range of 0.22 to 1.46 dS/m with in 30 cm depth with low concentration below the point source, and higher concentration towards wetted periphery.

Table 4.6 D. Electrical conductivity profile under broad bed furrow irrigation system.

| Vertical depth from surface, (cm) | Electrical conductivity dS/m | | | | |
|---|---|------|------|------|------|
| | Sampling position as shown in fig. 4.10 A | | | | |
| | A | B | C | D | E |
| 0 | 0.94 | 0.72 | 0.82 | 0.72 | 0.93 |
| 10 | 0.71 | 0.65 | 0.73 | 0.62 | 0.68 |
| 20 | 0.48 | 0.46 | 0.55 | 0.47 | 0.49 |
| 30 | 0.31 | 0.29 | 0.32 | 0.28 | 0.33 |

From the Table 4.6 D and Fig. 4.10 it is clear that salt concentration increased from centre of bed (i.e. A sampling position) to the side of bed (i.e. at B and D sampling position) but increased exactly at center of bed. Thus salt concentration increased vertically at 20 cm depth from soil surface but decreased at 30 cm depth. The range of 0.36 to 1.15 dS/m was observed in the rootzone depth of summer groundnut crop.

Salt movement in soil under micro irrigation system is more complex than traditional BBF system. From Table 4.6 A, B, C and D, it is found that the electrical conductivity increased downwards in microsprinkler and BBF irrigation treatments. However, under drip and drip inline system, maximum salts were accumulated at the periphery of wetted zone on the soil surface. This may be due to fact that under drip and drip inline systems, salt movement in soil is associated with the flux of water; salts tend to accumulate at the wetted front between emitters

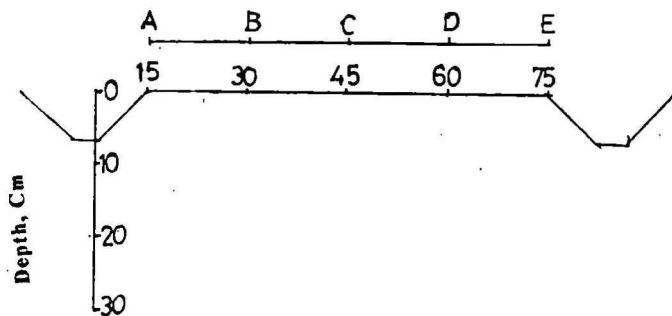


Fig 4.10 (a) Sampling positions.

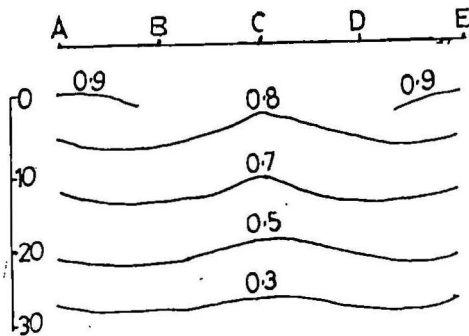


Fig 4.10 Electrical conductivity observed under broad bed furrow irrigation system.

where the flux reaches zero and at the soil surface where evaporation occurs. These results correspond with those obtained by Gustafson (1970)

4.5 Irrigation Efficiencies

Irrigation efficiency indicates how efficiently the available water supply is being used, based on different systems of evaluation. The knowledge of irrigation efficiency helps in better design of microirrigation system pipe network which is based on hydraulics of pipe flow.

In microsprinkler loss of irrigation water is from evaporation of spray and retention of water on the foliage. The standard systems were adopted to collect the observed data. From this data various efficiencies were calculated and results are presented in Table 4.7. The sample calculation to determine the efficiencies are presented in Appendix - C

Table 4.7 Application, distribution and water use efficiency of different irrigation treatments.

| Treatment | Application efficiency, (Percent) | Distribution efficiency (Percent) | Irrigation water use efficiency (q/ha-cm) | Field water use efficiency (q/ha-cm) |
|---------------------------------|-----------------------------------|-----------------------------------|---|--------------------------------------|
| T ₁ (Drip) | 89.46 | 96.23 | 0.57 | 0.55 |
| T ₂ (Microsprinkler) | 96.38 | 90.02 | 0.64 | 0.62 |
| T ₃ (Drip inline) | 88.13 | 95.76 | 0.60 | 0.58 |
| T ₄ (BBF) | 79.41 | 79.88 | 0.31 | 0.30 |

4.5.1 Application efficiency

Application efficiency shows how well irrigation water is applied i.e. what percentage of water applied is stored into the effective rootzone as required and available for plant use. From Table 4.7, it is observed that application efficiency ranges from 79.41 to 96.38 per cent in various irrigation treatments. In microsprinkler irrigation system, application efficiency was recorded as 96.38 per

cent which is maximum amongst rest of other treatments. This is followed by 89.46 per cent in drip and 88.13 per cent in micro inline system. The higher application efficiency in drip and microsprinkler irrigation as compared to broad bed furrow irrigation system might be due to the fact that in microirrigation system, the percolation losses below the crop rootzone and runoff losses were negligible

4.5.2 Distribution efficiency (Uniformity coefficient)

Distribution efficiency indicates the extent to the which water is uniformly distributed throughout the field. The efficiency of the microsprinkler irrigation system is low as compared to drip and drip inline. The distribution of water depends on the operating pressure, stake height of micro sprinkler, micro sprinkler spacing. The appropriate consideration to these parameters is important. Distribution efficiency was calculated by equation 3.7 for all the treatments, and results are presented in Table 4.7.

From Table 4.7, it revealed that the distribution efficiency was maximum in drip irrigation (96.23 per cent), followed by drip inline (95.76 per cent), microsprinkler (90.02 per cent) and broad bed furrow (79.88 per cent). The distribution efficiency was lowest in BBF irrigation treatment. This might be due to the application of water from one particular point and further allowing it to distribute over larger area which is affected by evaporation and leaching. The higher distribution efficiency in drip and drip inline might be due to fact that water is applied uniformly through point source of application and pattern is uniform. These results correspond with the results reported by Wu and Gitlin (1975) and Mankar (1989).

4.5.3 Water use efficiency

The water use efficiency is the production per unit volume of water. The observed data regarding yield and amount of water applied to summer groundnut crop were used to compute the water use efficiency of different treatments. The results are presented in Table 4.7.

Table 4.7 shows calculated values of irrigation water use efficiency and field water use efficiency. Microsprinkler irrigation treatment (T_2) recorded

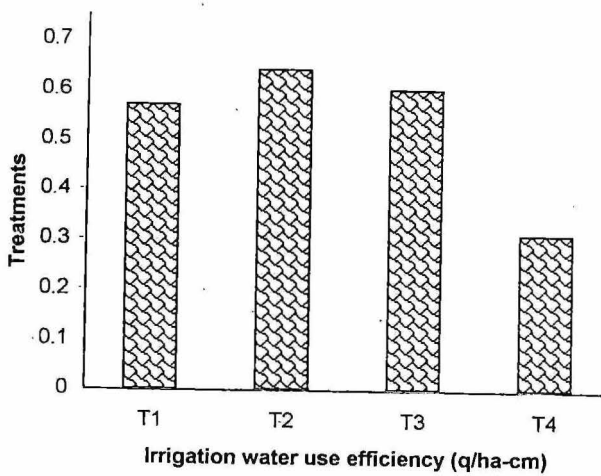


Fig 4.11 : Irrigation water use efficiency of the different irrigation treatments

highest 0.64 q/ha-cm and 0.62 q/ha-cm, irrigation and field water use efficiency respectively which is superior over rest of treatments, followed by drip inline (T_3) 0.60 and 0.58 q/ha-cm drip (T_1) 0.57 and 0.55 q/ha-cm and BBF (T_4) 0.31 and 0.30 q/ha-cm respectively. The higher water use efficiency in treatment of microsprinkler and drip inline irrigation system might be due to highest conservation of moisture and uptake of adequate amount of nutrients which produced high yield per unit amount of water, whereas the lowest water use efficiency in BBF treatment may be due to less yield and higher amount of water requirement as compared to microirrigation treatments. Fig. 4.11 show the effect of different irrigation treatments on water use efficiency.

4.6 Biometrics characters

The effect of different irrigation systems are studied on the basis of biometrics characteristics of summer groundnut crop. The field observations on each biometric character was taken and analysed. The results are discussed below.

4.6.1 Germination count

Germination count was taken, as number of plant emerged at 10 DAS, in the field to study the effect of various irrigation treatments. The results are presented in Table 4.8

Table 4.8 Mean germination count per plot and germination percentage as influenced by different irrigation treatments.

| Treatment | Germination Count | Germination Percentage |
|------------------------|-------------------|------------------------|
| T_1 (Drip) | 258.80 | 95.85 |
| T_2 (Microsprinkler) | 263.00 | 97.40 |
| T_3 (Drip inline) | 260.80 | 96.59 |
| T_4 (BBF) | 252.00 | 93.33 |
| Mean | 258.65 | |
| F Test | | Sig |
| S.E. (M) | | 1.50 |
| CD at 5 % | | 4.62 |

It can be seen from the Table 4.8, that the treatments microsprinkler, drip inline and drip systems are at par and recorded significantly highest germination count over control treatment of BBF. The microsprinkler system recorded highest germination count over rest of the treatments. From the data in the Table 4.8 it is seen that total germination percentage was 95.85, 97.40, 96.59 and 93.33 per cent in drip, microsprinkler, drip inline and BBF irrigation system respectively.

In microirrigation systems more seeds were germinated as compared to BBF irrigation system. This might be due to the fact that seed germination is mainly due to sunlight, soil moisture, soil nutrients and oxygen availability. In microirrigation treatments, the soil moisture could be maintained upto field capacity daily whereas it was not possible in BBF irrigation treatment due to irrigation intervals.

4.6.2 Height of plant (cm)

The data pertaining to mean plant height as influenced by different irrigation treatments are presented in Table 4.9. and graphically presented in Fig. 4.12

The mean plant height progressively increased during the course of plant growth. The rate of increase in plant height was observed between 45 to 60 DAS and later gradual upto harvest.

Table 4.9 Height of plant (cm) as influenced by different irrigation treatments

| Treatments | Days after sowing | | | | | |
|---------------------------------|-------------------|------|-------|-------|-------|-------|
| | 30 | 45 | 60 | 75 | 90 | AH |
| T ₁ (Drip) | 4.47 | 6.81 | 13.61 | 16.59 | 18.20 | 21.08 |
| T ₂ (Microsprinkler) | 4.62 | 7.78 | 14.29 | 17.62 | 19.42 | 22.29 |
| T ₃ (Drip inline) | 4.55 | 7.33 | 13.89 | 17.01 | 18.44 | 21.18 |
| T ₄ BBF | 4.44 | 6.55 | 13.05 | 16.21 | 17.94 | 20.35 |
| Mean | 4.52 | 7.11 | 13.71 | 16.85 | 18.5 | 21.22 |
| F test | NS | Sig | Sig | Sig | Sig | Sig |
| SE (M) | 0.26 | 0.26 | 0.16 | 0.19 | 0.27 | 0.27 |
| CD at 5% | 0.83 | 0.74 | 0.45 | 0.55 | 0.76 | 0.77 |

From the Table 4.9, it is revealed that at 30 DAS the differences in plant height due to irrigation systems were not significant. At 45 DAS the highest plant height was recorded in microsprinkler irrigation which was at par with drip inline system but significantly superior over drip and BBF system. The differences in plant height due to drip inline and drip systems so also between drip and BBF system were not significant. The later treatment recorded lowest plant height. More or less similar trends were recorded at 60 DAS.

At 75 DAS, the microsprinkler system recorded significantly highest plant height than rest of the system. Drip inline system being at par with drip system recorded significantly more height than BBF. Similarly the difference between drip and BBF was also not significant. Similar trend was recorded at 90 DAS and at harvest except that the microsprinkler and drip inline were at par at harvest.

4.6.3 Number of leaves per plant

The data in respect of number of leaves per plant as influenced by irrigation systems are presented in Table 4.10. The mean number of leaves were

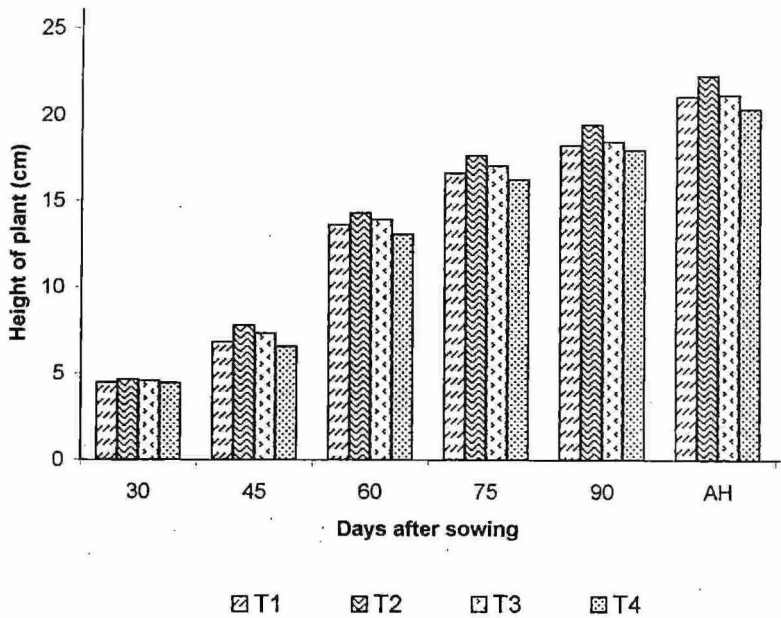


Fig 4.12 : Height of plants (cm) as influenced by different irrigation treatments

increased with advance in age of the crop progressively. Number of leaves per plant were significantly affected by the irrigation system at the respective observation dates.

Table 4.10 Number of leaves per plant as influenced by different irrigation treatments.

| Treatments | Days after sowing | | | | | |
|----------------|-------------------|-------|-------|-------|-------|-------|
| | 30 | 45 | 60 | 75 | 90 | AH |
| T ₁ | 19.65 | 31.53 | 50.09 | 62.79 | 81.32 | 91.70 |
| T ₂ | 22.10 | 33.08 | 52.79 | 66.09 | 88.75 | 95.52 |
| T ₃ | 20.31 | 31.62 | 50.85 | 63.20 | 80.05 | 94.51 |
| T ₄ | 17.90 | 29.81 | 48.03 | 61.35 | 78.50 | 90.80 |
| Mean | 19.99 | 31.51 | 50.44 | 63.35 | 82.15 | 93.13 |
| F test | Sig | Sig | Sig | Sig | Sig | Sig |
| SE (M) | 0.45 | 0.53 | 0.88 | 0.48 | 0.74 | 0.73 |
| CD at 5% | 1.28 | 1.51 | 2.49 | 1.36 | 2.08 | 2.07 |

From the Table 4.10, it is observed that at 30 DAS, microsprinkler system recorded significantly highest number of leaves than rest of the system. Drip inline and drip system being at par recorded significantly more number of leaves than BBF which recorded lowest number of leaves. Similar trend was recorded at 45 and 62 DAS except that the differences between microsprinkler and drip inline were not significant. At 75 and 90 DAS effect of irrigation system on number of leaves was exactly similar to that of 30 DAS. However at harvest the microsprinkler and drip inline being at par recorded significantly more number of leaves than drip and BBF. The later two systems were again at par.

4.6.4 Dry matter per plant

The data regarding the dry matter per plant in gm as influenced at all observations dates by different irrigation systems are presented in Table 4.11

The data in table 4.11 indicated that the dry matter accumulation rate was increased between 45 to 60 DAS. The mean dry matter weight per plant increased progressively at all observation dates.

Table 4.11 Dry matter per plant (g) as influenced by different irrigation treatments.

| Treatments | Days after sowing | | | | | |
|----------------|-------------------|------|-------|-------|-------|-------|
| | 30 | 45 | 60 | 75 | 90 | AH |
| T ₁ | 2.08 | 5.44 | 12.97 | 16.11 | 20.04 | 23.83 |
| T ₂ | 2.67 | 5.95 | 14.44 | 17.53 | 21.24 | 24.73 |
| T ₃ | 2.46 | 5.58 | 13.69 | 16.42 | 20.26 | 23.56 |
| T ₄ | 1.86 | 4.84 | 12.85 | 15.66 | 19.52 | 22.02 |
| Mean | 2.26 | 5.45 | 13.48 | 16.43 | 20.26 | 23.53 |
| F test | Sig | Sig | Sig | Sig | Sig | Sig |
| SE (M) | 0.09 | 0.13 | 0.28 | 0.13 | 0.26 | 0.21 |
| CD at 5% | 0.27 | 0.38 | 0.80 | 0.38 | 0.74 | 0.61 |

From the Table 4.11 it was observed that dry matter accumulation per plant was not significant amongst microsprinkler and drip inline system, but both were superior than drip and BBF. The later two were again at par. At 45 DAS the microsprinkler, drip inline and drip system were at par in affecting dry matter accumulation and all three systems were superior than BBF system. At 60 DAS the trend was exactly similar to 30 DAS. At 75 DAS the microsprinkler system recorded significantly higher dry matter accumulation. Drip inline and drip system being at par were superior than BBF. More or less similar trend was recorded at 90 DAS and exactly similar at harvest.

4.6.5 Mean leaf area (dm²) per plant as affected by different irrigation treatments.

The data in respect of mean leaf area of plant (dm²) as influenced by periodically by different irrigation treatments are presented in Table 4.12. The mean leaf area increased progressively at successive dates of observations upto 90 DAS, later on at harvest it decreased. The rate of increase in leaf area was highest at 60 to 75 DAS.

Table 4.12 Mean leaf area (dm²) per plant as affected by different irrigation treatments.

| Treatments | Days after sowing | | | | | |
|----------------|-------------------|------|-------|-------|-------|-------|
| | 30 | 45 | 60 | 75 | 90 | AH |
| T ₁ | 3.37 | 7.83 | 10.59 | 16.37 | 18.47 | 16.75 |
| T ₂ | 3.66 | 8.22 | 11.48 | 17.14 | 20.26 | 18.04 |
| T ₃ | 3.58 | 7.95 | 11.2 | 16.72 | 19.37 | 17.31 |
| T ₄ | 3.18 | 7.37 | 10.23 | 15.73 | 18.09 | 15.85 |
| Mean | 3.42 | 7.84 | 10.87 | 16.49 | 19.04 | 16.98 |
| F test | Sig | Sig | Sig | Sig | Sig | Sig |
| SE (M) | 0.07 | 0.09 | 0.15 | 0.28 | 0.28 | 0.34 |
| CD at 5% | 0.22 | 0.27 | 0.44 | 0.80 | 0.81 | 0.96 |

The highest leaf area was recorded at 30 DAS in microsprinkler system which was at par with drip inline and drip system but significantly superior over BBF. Similarly the drip inline and drip system were also superior over BBF, similar trend was recorded at 45 DAS. At 60 DAS, the microsprinkler and drip inline were at par and they were superior over drip and BBF. The later two treatments (T₁ and T₄) were again at par. Similar trend was recorded at 75 DAS.

At 90 DAS the leaf area was significantly highest in case of microsprinkler system. Drip inline system also recorded significantly more leaf area than drip system. However the differences in leaf area due to drip and BBF was not significant. More or less similar trend was recorded at harvest.

4.6.6 Mean number of pods per plant and weight of dry pods at harvest

The data in respect of number of developed and undeveloped pods per plant and weight of dry pods at harvest as influenced by irrigation system are presented in Table 4.13

Table 4.13 Mean number of pods per plant and weight of pods per plant as influenced by different irrigation treatments.

| Treatments | No. of Pods at harvest | | Weight of pods at harvest (g) |
|----------------|------------------------|-------------|-------------------------------|
| | Developed | Undeveloped | |
| T ₁ | 13.31 | 4.57 | 11.89 |
| T ₂ | 14.53 | 6.82 | 14.34 |
| T ₃ | 13.31 | 5.39 | 13.03 |
| T ₄ | 11.15 | 5.48 | 9.56 |
| Mean | 13.07 | 5.56 | 12.20 |
| F test | Sig | N.S. | Sig |
| SE (M) | 0.59 | 0.48 | 0.37 |
| CD at 5 %0 | 1.83 | 1.49 | 1.16 |

The results indicated that at harvest number of developed pods were recorded highest in microsprinkler system which was at par with drip inline and drip but significantly superior over BBF. Similarly drip inline and drip systems were superior over BBF but drip inline and drip were at par at harvest. Drip system was significantly superior over BBF which recorded lowest number of pods.

The data in above Table indicated that at harvest the differences in number of undeveloped pods per plant due to irrigation systems were not significant. Plate 4.5 shows the number of pod/plant.

The weight of pods (g) at harvest was recorded significantly highest in microsprinkler system followed by drip inline, drip and BBF. Similarly the drip inline was significantly superior over rest of later treatment. Drip system was significantly superior over BBF, which recorded lowest weight of pods at harvest.

4.6.7 Yield of Groundnut pods and haulm

The data pertaining to yield of pods and haulm are presented in Table 4.14 and graphically presented in Fig. 4.13. The mean yields of dry pods and haulm were 38.87 q/ha and 54.53 q/ha respectively. The dry pod and haulm yield was significantly influenced by irrigation treatment.



Plate 4.5 - Number of pods per plant at harvest



Plate 4.6 - Test weight of Kernels

Table 4.14 Pod and haulm yield (q/ha) as influenced by different irrigation treatments.

| Treatments | Dry pod yield (q/ha) | Percentage increase in dry pod yield with respect to BBF | Dry haulm yield (q/ha) |
|------------|----------------------|--|------------------------|
| T1 | 40.35 | 49.44 | 56.84 |
| T2 | 45.6 | 68.88 | 62.71 |
| T3 | 42.56 | 57.62 | 56.15 |
| T4 | 27.00 | - | 42.45 |
| Mean | 38.87 | - | 54.53 |
| F test | Sig | - | Sig |
| SE (M) | 0.70 | - | 0.62 |
| CD at 5% | 2.16 | - | 1.32 |

From table 4.14, it was revealed that microsprinkler irrigation system the yield of dry pod (45.60 q/ha) was significantly highest over rest of the treatments. Dry pod yield in drip inline (42.56 q/ha) was significantly superior over drip (40.35 q/ha) and was more than BBF, which recorded lowest yield. (27.00 q/ha) Microsprinkler, Drip inline and drip irrigation treatments showed 68.88, 57.62 and 49.44 per cent higher dry pod yield as compared to broad bed furrow irrigation treatment. The maximum yield in treatment of (T₂) microsprinkler followed by drip inline (T₃) and drip (T₁) may be due to the availability of soil moisture in the rootzone of crop at zero tension without any water deficit, since water was applied daily. Due to this increase the yield potential of the crop as compared to BBF system to irrigation. The result obtained in this regard are similar with those reported by Patel and Patel (1986), Patel *et al.* (1990) and Anonymous (1995.b)

The results showed in Table 4.14 pertain to yield of dry haulm. The microsprinkler treatment yielded significantly highest haulm yield over rest of the treatments. Drip inline (T₃) was significantly superior over the treatment (T₁) of drip followed by BBF (T₄), which recorded lowest haulm yield.

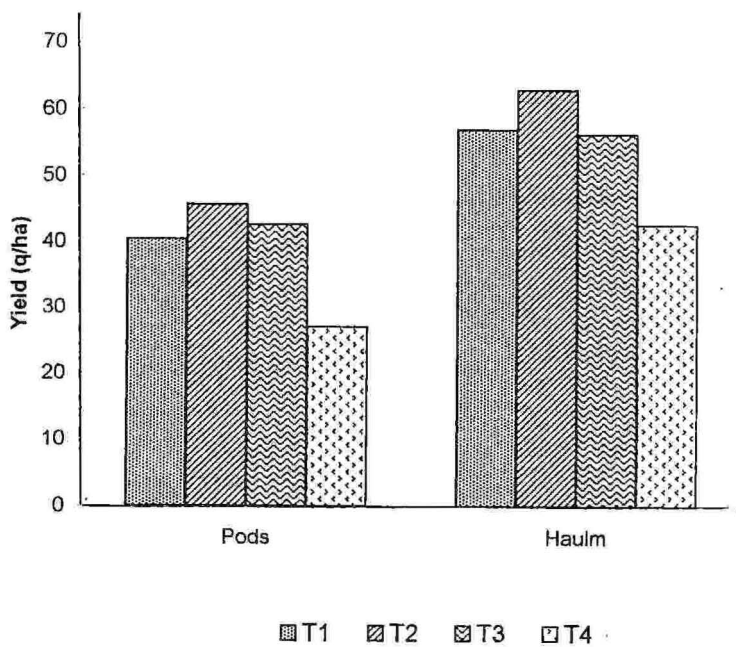


Fig 4.13 : Pods and Haulm yield (q/ha) as influenced by different irrigation treatments

4.6.8 Shelling percentage, test weight (g) and oil content (%)

The quality characters such as shelling percentage, test weight (gm) and oil content are presented in Table 4.15 and graphically presented in Fig. 4.14. The average shelling percentage, test weight and oil content were 72.39, 42.31 gm and 49.95 % respectively.

Table 4.15 Shelling percentage, test weight and oil content as influenced by different irrigation treatments.

| Treatments | Shelling percentage | Test weight (gm) | Oil content (%) |
|----------------|---------------------|------------------|-----------------|
| T ₁ | 71.44 | 41.69 | 49.60 |
| T ₂ | 75.50 | 43.77 | 51.20 |
| T ₃ | 71.80 | 42.58 | 50.17 |
| T ₄ | 70.76 | 41.23 | 48.84 |
| Mean | 72.39 | 42.31 | 49.95 |
| F test | NS | Sig | Sig |
| SE (M) | 1.41 | 0.17 | 0.26 |
| CD at 5 % | 4.19 | 0.48 | 0.75 |

From Table 4.15 it revealed that the differences in shelling percentage due to different irrigation systems were not significant.

The data in respect of test weight as influenced by irrigation treatments revealed significant effects. The test weight recorded by microsprinkler irrigation system was significantly highest over rest of the treatments. Drip inline was significantly superior over drip and BBF which were at par but BBF recorded lowest test weight amongst all treatments Plate 4.6 shows the test weight of kernels.

Oil content percentage differ significantly in irrigation treatments. The microsprinkler recorded significantly highest oil content in per cent over rest of the treatments, while drip inline, drip and BBF treatments were at par.

4.7 Cost economics

4.7.1 Cost of drip irrigation system

For determining the total cost per hectare of drip irrigation system, the fixed cost and operating cost were calculated as follows.

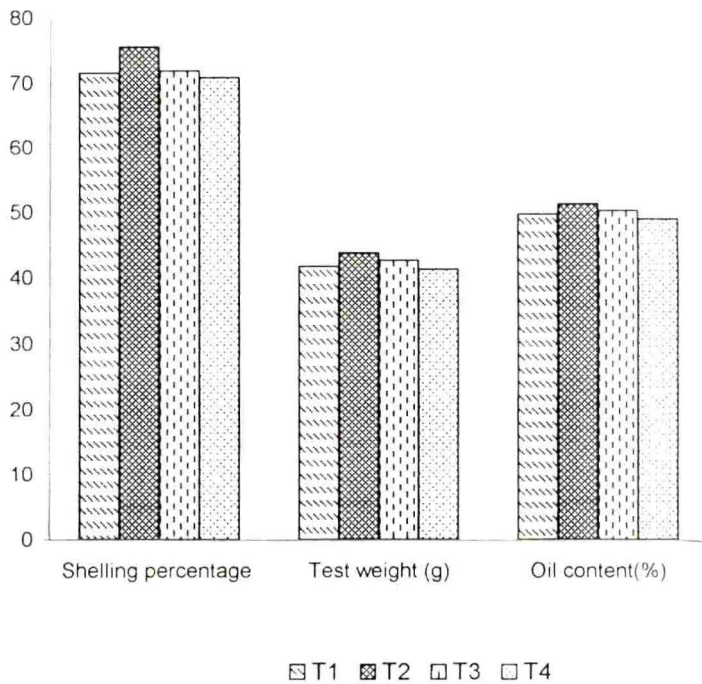


Fig 4.14 . Shelling percentage, test weight and oil content per cent as influenced by different irrigation treatments

I) fixed cost

Initial cost of (1,55,073 Rs/ha) drip irrigation system comprised of the cost of 1 HP pump coupled with an electric motor.

From initial cost, fixed cost in Rs/ha per year was calculated as follows.

| | |
|---|-----------------|
| 1) Interest on initial cost @ 16 per cent | 24811.68 |
| 2) Depreciation of system | <u>13686.00</u> |
| (From appendix D-III) | 38497.68 |

The motor and system can be used for three seasons in year. Therefore, fixed cost required for one crop season is 12832.56 Rs./ha

II) Operating cost

Management and input cost of drip irrigation system was calculated and presented in Appendix - D II

| | |
|---|-----------------|
| 1) Management and input cost (Rs/ha) | 10824.00 |
| 2) Interest on management and input cost for crop period of 4 months | 433.00 |
| @ 12 per cent per annum Rs/ha | <u>11257.00</u> |

III) Total cost

Total cost in Rs/ha for drip irrigation system is given below

$$\begin{aligned}\text{Total cost} &= \text{fixed cost} + \text{Operating cost} \\ &= 12832.56 + 11257 \\ &= 24090\text{Rs/ha.}\end{aligned}$$

4.7.2 Cost of microsprinkler irrigation system

For determining the total cost per hectare of microsprinkler irrigation system, the fixed cost and operating cost were calculated as follows.

I) fixed cost

Initial cost of (63,695 Rs/ha) microsprinkler irrigation system comprised of 1 HP pump coupled with an electric motor.

From initial cost, fixed cost in Rs/ha per year was calculated as follows.

| | |
|---|-----------------|
| 1) Interest on initial cost @ 16 per cent | 10191.20 |
| 2) Depreciation of system | 6637.00 |
| (From appendix D-III) | <u>16828.20</u> |

The motor and system can be used for three seasons in year. Therefore, fixed cost required for one crop season is 5609.40 Rs./ha

II) Operating cost

Management and input cost of microsprinkler irrigation system was calculated and presented in Appendix - D II

| | |
|--|-----------------------------|
| 1) Management and input cost (Rs/ha) | 10824.00 |
| 2) Interest on management and input cost | 433.00 |
| for crop period of 4 months | <u> </u> |
| @ 12 per cent per annum Rs/ha | 11257.00 |

III) Total cost

Total cost in Rs/ha for microsprinkler irrigation system is given below

$$\begin{aligned}
 \text{Total cost} &= \text{fixed cost} + \text{Operating cost} \\
 &= 5609.40 + 11257 \\
 &= 16866
 \end{aligned}$$

4.7.3 Cost of drip inline irrigation system

I) fixed cost

Initial cost of (1,58,667 Rs/ha) drip inline irrigation system comprised of 1 HP pump coupled with an electric motor.

From initial cost, fixed cost in Rs/ha per year was calculated as follows.

| | |
|---|-----------------|
| 1) Interest on initial cost @ 16 per cent | 25386.72 |
| 2) Depreciation of system | <u>14010.00</u> |
| (From appendix D-III) | 39396.72 |

The motor and system can be used for three seasons in year. There fore, fixed cost required for one crop season is 13132.24 Rs./ha

II) Operating cost

Management and input cost of drip irrigation system was calculated and presented in Appendix - D II

| | |
|---|----------|
| 1) Management and input cost (Rs/ha) | 10824.00 |
| 2) Interest on management and input cost for crop period of 4 months | 433.00 |
| @ 12 per cent per annum Rs/ha | 11257.00 |

III) Total cost -

Total cost in Rs/ha for drip inline irrigation system is given below-

$$\begin{aligned} \text{Total cost} &= \text{fixed cost} + \text{Operating cost} \\ &= 13132.24 + 11257 \\ &= 24389 \text{ Rs/ha.} \end{aligned}$$

4.7.4 Broad bed furrow irrigation system :

Initial cost of bbf system comprised of 2 HP pump coupled with electric motor.

From the initial cost of (7000 Rs/ha) fixed cost per year was calculated as follows

I) fixed cost

| | |
|--|---------------|
| 1) Interest on initial cost @ 16 per cent | 1120.00 |
| 2) Depreciation of system (From appendix D-III) | 252.00 |
| | 1372.00 Rs/ha |

The motor and system can be used for three seasons in year. There fore, fixed cost required for one crop season is 457.33 Rs./ha

II) Operating cost

Management and input cost of BBF irrigation system was calculated and presented in Appendix - D II

| | |
|---|----------|
| 1) Management and input cost (Rs/ha) | 12200.00 |
| 2) Interest on management and input cost for crop period of 4 months | 488.00 |
| @ 12 per cent per annum Rs/ha | 12688.00 |

III) Total cost –

Total cost in Rs/ha for BBF irrigation system is given below-

$$\begin{aligned}\text{Total cost} &= \text{fixed cost} + \text{Operating cost} \\ &= 457.33 + 12688 \\ &= 13145 \text{Rs/ha.}\end{aligned}$$

4.7.5 Economics of the study

The pod yield haulm yield, gross return, total cost, net return, seasonal additional benefits on account of improvements, cost of providing these benefits and benefit cost ratio were calculated for each treatment by incremental benefit system and presented in Table 4.16

From the Table 4.16, it is observed that the gross return was due to production of pods and haulm in hectare with selling market rate as 1400 Rs/ha and 250 Rs/ha respectively. The total production in Rs/ha including pods and haulm yield was a gross return.

From Table, it is seen that the net return of (62,652 Rs/ha) was observed in microsprinkler irrigation system, which was highest amongst all other treatments, followed by drip inline (49,233 Rs/ha) and drip (46,610 Rs/ha) respectively. Control treatment of BBF recorded lowest net return of (32,568 Rs/ha)

The benefit cost ratio calculated by incremental benefit system over BBF showed maximum value of 7.35 in microsprinkler system followed by drip inline 1.24 and drip 1.03 respectively.

Considering the water as scarce commodity than land, the expected yield, expected gross return, expected net return, expected total cost and expected net

Table 4.16 Cost economics of the study

| Treatment | Yield (q/ha) | | Gross return Rs/ha (A+B) | Total cost Rs/ha | Net return Rs/ha | Seasonal additional benefits on account of improvement (Rs/ha) | Seasonal cost of providing these benefits (Rs/ha) | B/c ratio |
|----------------|--------------------------|-------------------------|--------------------------|------------------|------------------|--|---|-----------|
| | Main produce (Pods) A | By product (Haulm) B | | | | | | |
| T ₁ | 40.35 (56,490) | 56.84 (14,210) | 70.700 | 24,090 | 46,610 | 11,342 | 10945 | 1.03 |
| T ₂ | 45.60 (63,840) | 62.71 (15,678) | 79518 | 16,866 | 62,652 | 27,384 | 3721 | 7.35 |
| T ₃ | 42.56 (59,584) | 56.15 (14,038) | 73622 | 24,389 | 49,233 | 13,965 | 11244 | 1.24 |
| T ₄ | 27.00 (37,800) | 42.45 (10,613) | 48413 | 13,145 | 35,268 | -- | - | - |

The market rate of pods is 1400 Rs/q

The market rate of haulm is 250 Rs/q

Figure in parenthesis indicate total production in Rs/ha.

return over broad bed furrow compare with microirrigation systems by utilizing 87.77 ha-cm of water was calculated for each treatment and presented in Table 4.17

The data of Table 4.17 revealed that the expected net return over broad bed furrow by utilizing same amount of water (87.77 ha-cm) is found highest (77,876 Rs/ha) in microsprinkler irrigation system, which is superior over rest of the treatments followed by drip inline (61,197 Rs/ha) and drip (57,936 Rs/ha) respectively Hence, farmer can adopt the irrigation systems for summer groundnut suitable to him in order of ranking given above.

Table 4.17 : Predicted yield and cost economics based on BBF irrigation water requirement

| Treatment | Expected yield (q/ha) | | Expected Gros return Rs/ha A+B | Expected Total cost Rs/ha | Expected Net return Rs/ha | Expected return over BBF irrigtion system | Ranking |
|----------------|------------------------------------|--------------------------------|---|---------------------------------|---------------------------------|---|---------|
| | Main produce (Pods) A | By product (Haulm) B | | | | | |
| T ₁ | 50.15 (70,217) | 70.65 (17,663) | 87,880 | 29,994 | 57,936 | 22,668 | 3 |
| T ₂ | 56.68 (79,353) | 77.94 (19,488) | 98,841 | 20,964 | 77,876 | 42,608 | 1 |
| T ₃ | 52.90 (74,0623) | 69.79 (17,449) | 91,512 | 30,316 | 61,197 | 25,929 | 2 |
| T ₄ | 27.00 (37,800) | 42.45 (10,613) | 48,413 | 13,145 | 35,268 | -- | - |

The market rate of pods is 1400 Rs./q.

The market rate of haulm is 250 Rs/q

Figure in parenthesis indicate total production in Rs/ha.

CHAPTER V

SUMMARY AND CONCLUSIONS

The field experiment entitled “Comparative study of different irrigation methods for summer groundnut” was conducted on the field of Department of Irrigation and Drainage Engineering, Dr. PDKV, Akola. During the period from 2nd February to 26th May 2000 with Cv. TAG-24.

Initially soil of the experimental plot was analysed for its mechanical and chemical composition by adopting usual procedures. Chemical analysis of water was also performed to judge its quality. The quality was good for irrigation. The soil was clay loam with 30 cm average depth.

The experiment was conducted in randomized block design with irrigation treatment as a drip, microsprinkler, drip inline and BBF. Thus , four treatments were studied in five replications. In each plot of 2.7 m x 3 m size, kernels were dibbled per hill at a spacing of 30 cm x 10 cm on 2nd February 2000. All the plots were irrigated on the same day up to its field capacity. The irrigation for drip microsprinkler, and drip inline were scheduled daily equal to previous day crop evapotranspiration and for broad bed furrow, irrigation was scheduled at 40 mm CPE at the rate of IW/CPE ratio 0.75, with the depth of water applied equivalent to 30 mm. The solid fertilizer to all plots was applied at time of sowing based on recommended dose of fertilizer for summer groundnut (25:50:00 as NPK kg/ha)

The daily climatological data were collected from meteorological laboratory which was close to the experimental site. Evapotranspiration of summer groundnut crop was estimated by open pan evaporation system. The amount of water applied daily by microirrigation treatments was calculated on the basis of USWB class ‘A’ open pan evaporation system.

The soil moisture distribution and salt distribution was studied by collecting soil samples at various depths up to effective root zone (30 cm), for each treatments at various positions in the plot. Irrigation efficiencies were determined for all treatments. The biometrics character related to germination, growth, yield and quality of crop i.e. height of plant, number of leaves, dry matter per plant, leaf area per plant, number of pods per plant, weight of pods per plant, pod yield q/ha, haulm yield q/ha, shelling percentage, test weight and oil content (%) of kernels were studied. The observed data were analysed and conclusions have been drawn. Lastly, cost economics was worked out for each irrigation treatment for better comparison and to help the farmers to select the system.

Following are the conclusions

- 1) The evapotranspiration and water requirement of summer groundnut was found to increase till the end of mid season stage and further, decline in late season stage in all treatments.
- 2) The total evapotranspiration of summer groundnut was found to be 699.481 mm. The net irrigation water requirement of groundnut was found to be 87.77 ha-cm under BBF irrigation system, while 70.61 ha-cm under drip, microsprinkler, drip inline irrigation systems. Thus water saving under microirrigation treatments over BBF irrigation system was 19.55 per cent.
- 3) By adopting microirrigation system the area can be increased by 24.30 per cent.
- 4) In drip microsprinkler and drip inline soil moisture was continuously maintained close to the field capacity in the rootzone and was available to the plant at lower soil moisture tension, which improved the uptake of nutrients, while in BBF irrigation, it was 20% less than field capacity. Soil moisture deficit was observed in the rootzone of crop before next irrigation.
- 5) Salt accumulation increased downwards under microsprinkler and BBF irrigation systems, however under drip and drip inline irrigation system maximum salts were accumulated at the periphery of the wetted zone to the soil surface.

- 6) The application efficiency in different treatments were ranging from 79.41 to 96.38 per cent and was found maximum (96.38 per cent) in microsprinkler irrigation treatment. While distribution efficiency ranged from 79.88 to 96.23 per cent with maximum (96.23 per cent) in drip irrigation.
- 7) Irrigation water use efficiency ranged from 0.31 to 0.64 q/ha-cm and was found maximum in microsprinkler irrigation system. (0.64 q/ha-cm) by conservation of moisture and uptake of adequate amount of nutrients producing higher growth, yield and quality of pods per unit amount of water applied and nutrient consumption.
- 8) Height of plant, number of leaves, dry matter per plant, leaf area per plant was found significantly superior in microsprinkler irrigation treatment (T2) followed by drip inline (T3) and drip (T1). This is due to uniform spreading of water without any stress in the root zone of crop and steady availability of nutrients, which ultimately creates favourable microclimate for plant growth.
- 9) The mean number of developed pods per plant in microsprinkler treatment (T2) was at par with drip inline treatment (T3) and drip treatment (T2), but significantly superior over BBF (T4) at harvest. The differences in number of undeveloped pods per plant due to irrigation systems were not significant at harvest. The weight of pods per plant was recorded significant at harvest. The weight of pods per plant was recorded significantly highest in microsprinkler treatment (T2) followed by drip inline(T3) and drip (T1) over control treatment of BBF (T4)
- 10) Yield of dry pods and haulm was significantly superior in microsprinkler treatment (T2) over rest of the treatments. Drip inline (T3) was superior over drip treatment (T2), but BBF treatment recorded lowest yield of dry pods and haulm.
- 11) The differences in shelling percentage due to different irrigation systems were not significant, however test weight (g) and oil content percentage was significantly superior in microsprinkler irrigation treatment (T2) over rest of the treatments.

- 12) The expected net return over the BBF treatment can also increased by Rs 42,608., RS 25,929 and Rs. 22,668 per ha by adopting microsprinkler, drip inline and drip irrigation system respectively, due to higher area covered with same amount of water and better quality and quantity of produce was obtained through it.
- 13) On the basis of benefit cost ratio and water use efficiency, farmers can adopt microsprinkler system for summer groundnut which showed the B/C ratio of 7.35.

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* Original not seen

APPENDIX A

Daily meteorological data from 2nd February,2000 to 26th May,2000.

| Months and Dates | Temp °C | | RH (%) | | Open pan evaporation (mm) | Rainfall (mm) |
|------------------|---------|------|---------|---------|---------------------------|---------------|
| | Max | Min | Morning | Evening | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Feb,2000 | | | | | | |
| 2 | 31.3 | 14.0 | 58 | 21 | 5.6 | 00 |
| 3 | 30.7 | 13.3 | 62 | 22 | 5.0 | 00 |
| 4 | 30.8 | 13.4 | 62 | 33 | 5.2 | 00 |
| 5 | 32.0 | 16.1 | 66 | 26 | 4.6 | 00 |
| 6 | 29.2 | 13.9 | 54 | 28 | 6.0 | 00 |
| 7 | 27.7 | 10.6 | 54 | 29 | 5.2 | 00 |
| 8 | 28.0 | 10.5 | 62 | 30 | 4.6 | 00 |
| 9 | 30.4 | 11.0 | 61 | 27 | 3.9 | 00 |
| 10 | 30.6 | 10.0 | 53 | 28 | 4.9 | 00 |
| 11 | 32.0 | 17.0 | 42 | 25 | 6.0 | 00 |
| 12 | 28.2 | 16.0 | 45 | 27 | 7.8 | 00 |
| 13 | 28.0 | 12.5 | 49 | 26 | 4.8 | 00 |
| 14 | 28.9 | 14.0 | 53 | 27 | 5.3 | 00 |
| 15 | 29.2 | 14.5 | 52 | 28 | 5.6 | 00 |
| 16 | 31.2 | 18.0 | 70 | 30 | 4.6 | 00 |
| 17 | 33.5 | 14.0 | 45 | 18 | 6.4 | 00 |
| 18 | 31.0 | 9.2 | 54 | 15 | 6.8 | 00 |
| 19 | 30.5 | 10.2 | 44 | 14 | 6.0 | 00 |
| 20 | 30.6 | 11.5 | 40 | 24 | 7.0 | 00 |
| 21 | 30.4 | 13.0 | 90 | 26 | 5.0 | 00 |
| 22 | 30.2 | 14.4 | 87 | 25 | 5.4 | 00 |
| 23 | 31.3 | 15.0 | 70 | 39 | 6.4 | 00 |
| 24 | 30.7 | 15.2 | 97 | 82 | 3.2 | 25.2 |
| 25 | 31.8 | 13.5 | 85 | 64 | 3.2 | 00 |
| 26 | 25.8 | 16.6 | 92 | 49 | 3.0 | 00 |
| 27 | 27.8 | 14.3 | 73 | 25 | 3.4 | 00 |
| 28 | 31.5 | 13.6 | 53 | 13 | 4.8 | 00 |
| 29 | 33.0 | 13.0 | 52 | 11 | 7.0 | 00 |

| Months and Dates | Temp °C | | RH (%) | | Open pan evaporation (mm) | Rainfall (mm) |
|------------------------|---------|------|---------|---------|---------------------------------|------------------|
| | Max | Min | Morning | Evening | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Mar.2000 | | | | | | |
| 1 | 34.7 | 13.0 | 48 | 11 | 5.6 | 00 |
| 2 | 37.2 | 17.7 | 45 | 12 | 6.8 | 00 |
| 3 | 36.6 | 19.5 | 44 | 14 | 10.0 | 00 |
| 4 | 36.6 | 19.0 | 41 | 19 | 10.3 | 00 |
| 5 | 35.0 | 17.0 | 33 | 20 | 8.8 | 00 |
| 6 | 34.2 | 15.1 | 50 | 14 | 7.6 | 00 |
| 7 | 35.2 | 18.1 | 42 | 23 | 7.6 | 00 |
| 8 | 32.4 | 18.5 | 42 | 17 | 8.4 | 00 |
| 9 | 33.0 | 14.6 | 43 | 16 | 9.2 | 00 |
| 10 | 33.6 | 11.4 | 38 | 14 | 8.4 | 00 |
| 11 | 35.5 | 18.0 | 32 | 15 | 9.0 | 00 |
| 12 | 36.0 | 18.0 | 35 | 19 | 10.2 | 00 |
| 13 | 36.0 | 18.4 | 38 | 16 | 12.4 | 00 |
| 14 | 32.5 | 18.0 | 60 | 21 | 9.4 | 00 |
| 15 | 33.2 | 14.0 | 44 | 20 | 9.1 | 00 |
| 16 | 34.8 | 13.0 | 42 | 21 | 8.0 | 00 |
| 17 | 35.0 | 18.0 | 42 | 24 | 8.4 | 00 |
| 18 | 36.0 | 18.0 | 40 | 22 | 9.0 | 00 |
| 19 | 36.1 | 16.4 | 33 | 22 | 11.2 | 00 |
| 20 | 36.4 | 15.0 | 36 | 20 | 8.4 | 00 |
| 21 | 36.4 | 15.0 | 36 | 20 | 8.6 | 00 |
| 22 | 38.2 | 17.6 | 38 | 18 | 9.4 | 00 |
| 23 | 28.0 | 19.4 | 38 | 22 | 10.2 | 00 |
| 24 | 36.2 | 16.3 | 42 | 24 | 8.6 | 00 |
| 25 | 36.9 | 17.4 | 43 | 13 | 10.9 | 00 |
| 26 | 35.6 | 17.0 | 31 | 12 | 10.8 | 00 |
| 27 | 37.0 | 17.8 | 31 | 9 | 9.8 | 00 |
| 28 | 37.2 | 16.9 | 28 | 10 | 7.4 | 00 |
| 29 | 37.8 | 17.8 | 29 | 10 | 9.8 | 00 |
| 30 | 39.7 | 17.4 | 26 | 9 | 10.3 | 00 |
| 31 | 40.2 | 16.4 | 27 | 10 | 11.6 | 00 |

| Months and Dates | Temp °C | | RH (%) | | Open pan evaporation (mm) | Rainfall (mm) |
|------------------------|---------|------|---------|---------|---------------------------------|------------------|
| | Max | Min | Morning | Evening | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| April, 2000 | | | | | | |
| 1 | 41.0 | 17.2 | 29 | 8 | 10.6 | 00 |
| 2 | 42.0 | 18.5 | 27 | 9 | 10.1 | 00 |
| 3 | 42.0 | 19.8 | 29 | 8 | 9.6 | 00 |
| 4 | 42.0 | 21.0 | 28 | 7 | 11.2 | 00 |
| 5 | 42.0 | 25.5 | 29 | 12 | 11.2 | 00 |
| 6 | 42.2 | 25.0 | 31 | 12 | 11.4 | 00 |
| 7 | 42.2 | 24.5 | 29 | 7 | 12.4 | 00 |
| 8 | 43.0 | 24.7 | 27 | 6 | 10.4 | 00 |
| 9 | 43.0 | 26.7 | 24 | 6 | 12.6 | 00 |
| 10 | 42.2 | 20.4 | 28 | 10 | 15.2 | 00 |
| 11 | 42.0 | 22.0 | 32 | 13 | 11.6 | 00 |
| 12 | 43.5 | 22.6 | 24 | 19 | 10.0 | 00 |
| 13 | 43.0 | 21.6 | 232 | 9 | 11.3 | 00 |
| 14 | 43.6 | 22.0 | 39 | 14 | 11.5 | 00 |
| 15 | 42.5 | 25.5 | 43 | 12 | 15.1 | 00 |
| 16 | 41.7 | 26.5 | 42 | 14 | 12.6 | 00 |
| 17 | 42.0 | 24.7 | 43 | 12 | 13.7 | 00 |
| 18 | 42.6 | 24.5 | 25 | 11 | 13.2 | 00 |
| 19 | 42.6 | 24.5 | 25 | 15 | 13.4 | 00 |
| 20 | 42.0 | 24.0 | 32 | 11 | 12.4 | 00 |
| 21 | 43.0 | 24.5 | 28 | 13 | 13.4 | 00 |
| 22 | 43.0 | 25.9 | 32 | 26 | 11.5 | 00 |
| 23 | 41.0 | 22.8 | 34 | 17 | 11.0 | 00 |
| 24 | 40.5 | 26.8 | 36 | 17 | 16.0 | 00 |
| 25 | 41.0 | 24.0 | 39 | 17 | 19.6 | 00 |
| 26 | 41.2 | 26.0 | 37 | 16 | 20.0 | 00 |
| 27 | 42.0 | 26.5 | 37 | 12 | 19.4 | 00 |
| 28 | 43.3 | 26.8 | 44 | 11 | 19.0 | 00 |
| 29 | 43.0 | 28.0 | 37 | 9 | 30.3 | 00 |
| 30 | 43.0 | 26.0 | 37 | 12 | 17.3 | 00 |

| Months and Dates | Temp °C | | RH (%) | | Open pan evaporation (mm) | Rainfall (mm) |
|------------------------|---------|------|---------|---------|---------------------------------|------------------|
| | Max | Min | Morning | Evening | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| May 2000 | | | | | | |
| 1 | 42.8 | 26.0 | 31 | 11 | 17.6 | 00 |
| 2 | 43.5 | 27.8 | 28 | 12 | 16.4 | 00 |
| 3 | 44.0 | 27.9 | 34 | 8 | 16.0 | 00 |
| 4 | 45.0 | 28.7 | 36 | 9 | 18.8 | 00 |
| 5 | 45.0 | 29.7 | 40 | 10 | 15.0 | 00 |
| 6 | 45.0 | 25.2 | 44 | 18 | 15. | 00 |
| 7 | 44.7 | 23.0 | 60 | 20 | 13.8 | 3.6 |
| 8 | 40.6 | 20.6 | 68 | 26 | 7.8 | 0.4 |
| 9 | 38.0 | 26.3 | 52 | 18 | 10.0 | 00 |
| 10 | 40.0 | 23.0 | 53 | 23 | 12.0 | 00 |
| 11 | 39.2 | 26.6 | 53 | 21 | 12.6 | 00 |
| 12 | 40.3 | 26.0 | 52 | 25 | 14.8 | 00 |
| 13 | 38.5 | 25.5 | 49 | 23 | 15.0 | 00 |
| 14 | 39.6 | 26.5 | 47 | 20 | 15.8 | 00 |
| 15 | 40.6 | 27.5 | 41 | 23 | 14.4 | 00 |
| 16 | 40.6 | 28.0 | 52 | 23 | 17.0 | 00 |
| 17 | 39.8 | 28.0 | 50 | 28 | 15.0 | 00 |
| 18 | 40.7 | 27.6 | 48 | 26 | 15.4 | 00 |
| 19 | 38.0 | 25.0 | 55 | 63 | 10.3 | 1.5 |
| 20 | 29.7 | 24.6 | 68 | 54 | 5.0 | 2.2 |
| 21 | 32.0 | 24.3 | 65 | 37 | 6.2 | 1.0 |
| 22 | 37.0 | 26.2 | 52 | 32 | 12.6 | 00 |
| 23 | 38.7 | 27.2 | 55 | 28 | 12.6 | 00 |
| 24 | 39.7 | 27.3 | 54 | 25 | 15.5 | 00 |
| 25 | 40.2 | 27.0 | 50 | 28 | 17.3 | 00 |
| 26 | 40.0 | 27.0 | 58 | 27 | 17.0 | 00 |

APPENDIX -B

Water requirement of summer groundnut

The first irrigation was given up to field capacity to all irrigation treatments.

Sample Calculation

- I) The amount of irrigation water required up to field capacity was calculated by the equation given in below

$$d = \frac{M_{fc} - M_{bi}}{100} \times AS \times D_s$$

In which

d = Net amount of water to be applied during an irrigation, cm

M_{fc} = Field capacity moisture content of the soil, per cent

M_{bi} = Moisture content before irrigation per cent

AS = Bulk density

D = Depth of effective rootzone, cm

$$d = \frac{32 - 21.52}{100} \times 1.2 \times 30$$

$$= 3.77 \text{ cm}$$

Amount of water required per plot of summer groundnut crop

$$= 3.77 \times 8.1$$

$$= 305.37 \text{ Litres} \approx 306 \text{ Litres}$$

or

$$= \frac{3.77}{100} \times 8.1 \times 1000$$

$$= 305.37 \text{ liters}$$

$$= 306 \text{ liters.}$$

- II) Daily water requirement of summer groundnut under Drip/Microsplinker /drip inline irrigation system was calculated by using USWB Class ;A; open pan evaporation method

$$Q = A \times E_{pan} \times k_p \times K_c$$

In which,

A = Area of Plot, m²

Epan = Previous day pan evaporation,

Kp = Pan coefficient (0.7 mm)

Kc = Crop coefficient

Amount of water applied per plot on 21st April 2000

$$= 8.1 \times 13.4 \times 0.7 \times 1$$

$$= 75.97 \text{ Lits/plot}$$

- III) In broad bed irrigation method, irrigation was applied when CPE reached to 40 mm at the rate of IW/CPE ratio of 0.75

Amount of water required = d x A

in BBF treatment per = 30 x 8.1

Plot per irrigation, litres = 243 litres

IW

$$\text{-----} = 0.75$$

CPE

$$IW = 0.75 \times CPE$$

$$= 0.75 \times 40$$

$$= 30 \text{ mm}$$

$$= 3 \text{ cm}$$

$$= 0.03 \text{ m}$$

$$\text{area} = 8.1 \text{ m}^2$$

Volume = Area x depth

$$= 8.1 \times 0.03 \text{ m}$$

$$= 0.243 \text{ m}^3$$

$$= 0.243 \times 1000$$

$$V = 243 \text{ litres}$$

Amount of water applied when CPE reached to 40 mm.

APPENDIX- C

Irrigation efficiencies

A) Application efficiency of drip system

The equation used to calculate the application efficiencies of drip and drip inline and microspinkler system used given below

$$Eq = \frac{e \times q_{\min} \times T}{V} \times 100$$

Sample calculation

| Sr. No. | Discharge | Deviation from mean |
|---------|-----------|---------------------|
| 1 | 3.72 | 0.13 |
| 2 | 3.85 | 0.00 |
| 3 | 3.86 | 0.01 |
| 4 | 4.12 | 0.01 |
| 5 | 3.57 | 0.28 |
| 6 | 3.82 | 0.03 |
| 7 | 4.15 | 0.30 |
| 8 | 4.12 | 0.27 |
| 9 | 3.60 | 0.25 |
| 10 | 3.72 | 0.13 |
| 11 | 3.84 | 0.01 |
| 12 | 4.08 | 0.23 |
| 13 | 3.96 | 0.11 |
| 14 | 3.95 | 0.10 |
| 15 | 4.12 | 0.27 |
| 16 | 3.48 | 0.27 |
| 17 | 3.86 | 0.01 |
| 18 | 3.45 | 0.40 |
| 19 | 3.92 | 0.07 |
| 20 | 3.92 | 0.07 |
| 20 | 3.88 | 3.03 |
| 22 | 3.95 | 0.10 |
| 23 | 3.84 | 0.01 |
| 24 | 3.73 | 0.12 |
| 25 | 3.90 | 0.05 |
| 26 | | |

Sum 94.41

3.62

Mean 3.85

0.14

a) Application efficiencies for drip irrigation treatment

$$\begin{aligned}
 Eq &= \frac{e \times q_{\min} \times T}{V} \times 100 \\
 &= \frac{25 \times 3.45 \times 1}{96.41} \\
 &= 0.8946 \times 100 \\
 &= 89.46
 \end{aligned}$$

b) Distribution efficiency of drip

$$\begin{aligned}
 Cu &= \left[1 - \frac{\sum x}{mn} \right] \times 100 \\
 X &= 3.62 \\
 m &= 3.85 \\
 n &= 25 \\
 &= 1 - \frac{3.62}{3.85 \times 25} \times 100 \\
 &= \left(1 - \frac{3.62}{96.25} \right) \times 100 \\
 &= (1 - 0.0376) \times 100 \\
 &= 0.9623 \times 100 \\
 0.9624 &= 96.23 \% \\
 &= 96.23
 \end{aligned}$$

A) Application efficiency of micro sprinkler irrigation system

$$\begin{aligned}
 Eq &= \frac{e \times q_{\min} \times T}{V} \times 100 \\
 &= \frac{2 \times 85.40 \times 1}{180} \times 100 \\
 &= 0.9638 \times 100 \\
 &= 96.38
 \end{aligned}$$

B) Uniformity co-efficients of microsprinkler irrigation system

$$\begin{aligned}
 C_u &= \left[1 - \frac{\sum x}{mn} \right] \times 100 \\
 &= \left(1 - \frac{17.6}{176.30} \right) \\
 &= 100 \times 0.90020 \\
 C_u &= 90.02 \%
 \end{aligned}$$

A) Application efficiency of drip inline system

$$\begin{aligned}
 Eq &= \frac{e \times q_{\min} \times T}{V} \times 100 \\
 &= \frac{25 \times 2.60 \times 1}{73.75} \times 100 \\
 &= \frac{65}{73.75} \times 100 \\
 &= 0.8813 \times 100 \\
 &= 88.13
 \end{aligned}$$

B) Distribution efficiency of drip inline irrigation system

$$Cu = \left[1 - \frac{\sum x}{mn} \right] \times 100$$

$$Cu = 1 - \frac{3.12}{2.95 \times 25} \times 100$$

$$= (1 - 0.0423 \times 100)$$

$$= 95.76 \%$$

A) Irrigation efficiencies of BBF irrigation systems

| Depth before irrigation (cm/m) | Depth after irrigation (cm/m) | Storage depth | Depth in descending order | Numerical deviations |
|--------------------------------|-------------------------------|---------------|---------------------------|----------------------|
| 27.62 | 33.11 | 5.49 | 7.17 | 1.87 |
| 25.86 | 30.5 | 4.79 | 6.89 | 1.59 |
| 25.92 | 31.59 | 5.67 | 6.75 | 1.45 |
| 26.55 | 33.72 | 7.17 | 6.53 | 1.23 |
| 25.19 | 29.47 | 4.28 | 6.52 | 1.22 |
| 27.14 | 32.36 | 5.22 | 5.71 | 0.41 |
| 30.17 | 34.09 | 3.92 | 5.67 | 0.37 |
| 34.64 | 35.47 | 0.83 | 5.5 | 0.2 |
| 26.26 | 33.15 | 6.89 | 5.49 | 0.19 |
| 27.92 | 33.42 | 5.5 | 5.22 | 0.08 |
| 30.26 | 35.97 | 5.71 | 4.83 | 0.47 |
| 33.12 | 33.97 | 4.83 | 4.79 | 0.51 |
| 26.23 | 32.76 | 6.53 | 4.7 | 0.6 |
| 26.32 | 33.07 | 6.75 | 4.28 | 1.02 |
| 26.84 | 31.54 | 4.7 | 3.92 | 1.38 |
| 29.31 | 35.83 | 6.52 | 0.83 | 4.47 |
| | | Mn=84.8 | | 17.06 |

$$\text{Mean} = \frac{84.8}{16}$$

$$= 5.3$$

$$84.8$$

Average depth of storage =

$$17.06$$

$$= 4.97.$$

$$C_u = \left[1 - \frac{Y}{d} \right] \times 100$$

$$= 1 - \frac{17.06}{84.8} \times 100$$

$$C_u = 79.88$$

(a) Application efficiency of BBF irrigation system

$$E_a = \frac{W_s}{W_f} \times 100$$

$$\frac{243 \times 100}{306}$$

$$= 0.7941 \times 100$$

$$= 79.41 \%$$

II) Water use efficiency (Irrigation water use efficiency and field water use efficiency)

the equation use to calculate the irrigation water use efficiency is given below,

a) For drip irrigation system

$$E_{uI} = \frac{Y}{WR}$$

$$\frac{40.35}{70.61}$$

$$= 0.57$$

The field water use efficiency is calculated from the equation

$$E_{uF} = \frac{Y}{WR + UR}$$

$$\frac{40.35}{72.61}$$

$$= 0.55$$

b) For micro sprinkler irrigation system

$$Eu_f = \frac{Y}{WR}$$
$$\frac{45.6}{70.61} = 0.64$$

The field water use efficiency is calculated from the equation

$$Eu_f = \frac{Y}{WR + UR}$$
$$\frac{45.6}{72.61} = 0.62$$

b) For drip inline irrigation system

$$Eu_f = \frac{Y}{WR}$$
$$\frac{42.56}{70.61} = 0.60$$

The field water use efficiency is calculated from the equation

$$Eu_f = \frac{Y}{WR + UR}$$
$$\frac{42.56}{72.61} = 0.58$$

The irrigation water use efficiency for BBF

$$Eu_f = \frac{Y}{WR}$$

$$= \frac{27.00}{87.77} = 0.31$$

The field water use efficiency is calculated from the equation

$$\begin{aligned} E_{ur} &= \frac{Y}{WR + UR} \\ &= \frac{27}{89.77} = 0.30 \end{aligned}$$

APPENDIX DI

- I) Initial cost of irrigation system for summer groundnut common to drip microsprinkler and drip inline

| Cost component | Cost per unit, Rs | Unit | Cost Rs/ha |
|--|-------------------|------|------------|
| 1. Filter pressure gauge (No) | 3590 | 1 | 3590 |
| PVC mainline, 63mm (m) | 28 | 60 | 1680 |
| 3. PVC submain, 40 mm (m) | 22 | 100 | 2200 |
| 4. Ball valves, 40 mm (No) | 180 | 3 | 570 |
| 5. Reducer, 63 x 40 mm (No) | 20 | 3 | 60 |
| 6. Tee, 63mm (No) | 40 | 3 | 120 |
| 7. Endplug for submain | 2 | 3 | 60 |
| 8. Pump with electric motor, 1 HP (No) | 5000 | 1 | 5000 |
| | | | 13,280 |

- II) Initial cost of drip irrigation system

| Cost component | Cost per unit, Rs | Unit | Cost Rs/ha |
|---------------------------|-------------------|--------|------------|
| 1. Laterals , 12mm (m) | 4.20 | 16,667 | 70000 |
| 2. G.T.O. (No) | 4.00 | 335 | 1340 |
| 3. Drippers(No) | 2.50 | 27780 | 69450 |
| 4. End plug for lateral | 1.50 | 335 | 503 |
| 5. Installation of system | - | - | 500 |
| | | | 141793 |

III) Initial cost of micro sprinkler irrigation system

| Cost component | Cost per unit, Rs | Unit | Cost Rs/ha |
|-----------------------------------|-------------------|------|------------|
| 1. Laterals , 12mm (m) | 4.20 | 3333 | 13999 |
| 2. G.T.O. (No) | 4.00 | 66 | 264 |
| 3. Microsprinkler with stake (No) | 32 | 1111 | 35552 |
| 4. End plug for lateral (No) | 1.50 | 66 | 100 |
| 5. Installation of system | - | - | 500 |
| | | | 50415 |

IV) Initial cost of drip inline Irrigation system

| Cost component | Cost per unit, Rs | Unit | Cost Rs/ha |
|---------------------------|-------------------|--------|------------|
| 1. Laterals , 12mm (m) | 8.50 | 16,667 | 141679 |
| Poly joiner | 5.30 | 335 | 1776 |
| 3 End plug for lateral | 4.30 | 335 | 1441 |
| 4. Installation of system | - | - | 500 |
| | | | 145387 |

v) Initial cost of BBF irrigation system
 Initial cost of BBF system consist of electrical motor coupled with 2 HP pump
 (Rs.7000)

Initial cost

Total initial cost of different irrigation system are as follows

1. T1 – Drip irrigation system

Total initial cost = 13280 + 141793

(I + II) = 155073 Rs/ha.

2. T2 – Micro sprinkler irrigation system

Total initial cost = 13280 + 50415

(I + III) = 63695 Rs .ha

T3 – Drip inline irrigation system

Total initial cost = 13280 + 145387

(I + IV) = 158677 RS/ha

T4 – BBF irrigation system

Total initial cost = 7000 Rs/ha.

(V)

APPENDIX D (II)

Management and input cost of summer groundnut Rs/ha

| Items | Treatments | | | |
|---------------------------|------------|-------|-------|-------|
| | T1 | T2 | T3 | T4 |
| A) Services | | | | |
| 1. Prepreatory tillage | 1663 | 1663 | 1663 | 1663 |
| 2. Layout of field | 148 | 148 | 148 | 148 |
| 3. Preperation of BBF | - | - | - | 474 |
| 4. Dibbleing | 555 | 555 | 555 | 555 |
| 5. fertlizers application | 74 | 74 | 74 | 74 |
| 6. Weeding | 555 | 555 | 555 | 555 |
| 7. Irrigation | 555 | 555 | 555 | 1387 |
| 8. Harvesting | 259 | 259 | 259 | 259 |
| 9. Maintaince | 50 | 50 | 50 | 00 |
| 10. | | | | |
| Total service (I) | 3869 | 3869 | 3869 | 5115 |
| C) Inputs | | | | |
| 1. Groundnut seed | 5000 | 5000 | 5000 | 5000 |
| 2. Fertilizers (solid) | 1445 | 1445 | 1445 | 1445 |
| 3. Weedicide | 300 | 300 | 300 | 300 |
| 4. Energy charges | 120 | 120 | 120 | 240 |
| 5. PVC solution | 100 | 100 | 100 | 100 |
| Total inputs II | 6965 | 6965 | 6965 | 7085 |
| Grand total (I +II) | 10824 | 10824 | 10824 | 12200 |

APPENDIX- D III

Sample calculation

I) a) Depreciation on electric motor coupled with 1 HP

$$\frac{5000-500}{25} = \text{Rs. } 180$$

b) Depreciation on electric motor coupled with 2 HP

$$= \frac{7000-700}{25} = \text{Rs. } 252$$

II) Depreciation on drip irrigation system except motor pump

$$= \frac{150073-15007.3}{10} = 13506 \text{ Rs./ha}$$

Total depreciation of the drip irrigation system = 180+3506
= 13686 Rs/ha

III) Depreciation on Microsprinkler irrigation system except motor pump

$$\frac{58695-5869.5}{10}$$

$$= 6457 \text{ Rs./ha}$$

Total depreciation of the drip irrigation system = 180+6457
= 6637 Rs/ha

IV) Depreciation on drip inline irrigation system except motor pump

$$\frac{153667-15366.7}{10}$$

$$= 13830 \text{ Rs./ha}$$



Total depreciation of the drip irrigation system = 180+13830
= 14010 Rs/ha

V) Depreciation of BBF irrigation system is the depreciation of 2 HP pump coupled with motor.
= 252 Rs/ha

VITA

Prashant Ajabrao Gawande was born on 18th June 1975 at Rui (Gosta), Tq. Manora, District Washim (Maharashtra). He completed his middle School education from S.D. Primary School, Pusad and high school education from K.D. Vidyalaya, Pusad and passed S.S.C. examination in the year 1991 in first class. He passed his H.S.S.C. examination in the year 1993 from Phulsingh Naik Jr. College, Pusad Distt. Yavatmal with first class. He obtained his B.Tech (Agril. Engg.) degree from college of Agricultural Engineering and Technology Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola in the year 1998 with first class. After graduation he joined post graduate Institute, Dr. P.D.K.V., Akola, in the year 1998 leading to M. Tech (Agril. Engg.) degree in the discipline of Irrigation and Drainage Engineering.

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ABSTRACT

The field experiment was conducted with summer groundnut (*Arachis hypogaea* L.) at research farm for Department of Irrigation and Drainage Engineering, Dr. PDKV, Akola for comparative study of different irrigation systems for summer groundnut, during 2nd February 2000 up to 26th May 2000. The

experiment was conducted on clay loam soil in Randomised block design in five replications with treatments as drip, microsprinkler, drip inline and broad bed furrow irrigation. The irrigation for drip, microsprinkler and drip inline was scheduled daily equal to previous day crop evapotranspiration and for BBF treatment irrigation was scheduled at 40 mm CPE with IW/CPE ratio equal to 0.75.

The soil moisture distribution, irrigation efficiencies, the biometrics characters, crop yield and quality were studied using standard procedures. Lastly cost economics was worked out for each irrigation treatment for better comparison and selection by the farmers.

The net irrigation requirement was found to be 70.61 ha-cm in microirrigation and 87.77 ha-cm in broad bed furrow system respectively. The water saving in microirrigation treatment over broad bed furrow was 19.55 per cent.

In microirrigation treatments the moisture content was found closer to field capacity with uniform and even distribution of moisture and even distribution of moisture in the rootzone of crop. Which provides the favourable environment for plant growth as compared to traditional BBF irrigation system.

Salt concentration ^{was} found to be increased downward with depth in microsprinkler and BBF irrigation system, However, under drip inline and drip system maximum salts were accumulated at the periphery of wetted zone on the soil surface.

It is observed that application efficiency ranged from 79.41 to 96.38 per cent with maximum in microsprinkler treatment. Distribution efficiency found to be ranged of 79.88 to 96.23 per cent with maximum in drip and lowest in broad bed furrow treatment. Irrigation water use efficiency found to be maximum in microsprinkler irrigation (0.64 q/ha-cm) followed by drip inline (0.60 q/ha-cm) and drip (0.57 q/ha-cm) and lowest in BBF irrigation treatment (0.31 q/ha-cm).

The highest dry pod yield and haulm yield were found in microsprinkler treatment followed by drip inline, drip and broad bed furrow. The percentage increase in dry pod yield over broad bed furrow was 68.88, 57.62 and 49.44 microsprinkler, drip inline and drip respectively.

Considering water as a scare commodity through microirrigation treatments 24.30 per cent more area can be irrigated in 87.77 ha-cm of water which is requirement of broad bed furrow irrigation

On the basis of benefit cost ratio and water used efficiency , farmers can adopt microsprinkler system for summer groundnut which shows B/C ratio of 7.35 .

