

CHAPTER III

MATERIALS AND METHODS

MATERIALS AND METHODS

An accurate technique of study and careful selection of materials used are of prime importance for achieving high precision from the results of an experiment. Therefore, the present investigation was conducted for two consecutive years (1990-91 and 91-92) after a careful selection of material used and methods adopted, the details of which are given in succeeding pages:--

Experimental site:--

The experiment was layed out during the year 1990-91 and 1991-92 at the Vegetable Research Farm of Department of Horticulture, Udai Pratap Autonomous College, Varanasi. Geographically this area falls under humid subtropical climate and is located between $25^{\circ} 15'$ N latitude and $80^{\circ} 03'$ E longitude about 129.23 meters above mean sea level in the Gangetic alluvium of Eastern Uttar Pradesh, which is subjected to the extremes of weather conditions.

A sandy loam soil with neutral pH (7.1) and average fertility was selected. Before starting the experiment, representative soil sample upto 15 cm depth were taken for analysis. This sample was analysed for particle size distribution by International pipette method, total N by standard Kjeldahl, s method (Black, 1964), N by Alkaline permaganate method (Subbiah and Asija, 1956), available P by phosphomolybdate method (Black, 1964), available K by flamephotometrically, pH value (1:2.5 suspension) by Systronic pH meter using glass electrode and organic carbon by Walkley and Black rapid titration method (Black, 1964) and were noted in Table 1.

Table 1

Physical and chemical properties of the soil of experimental site:-

| Components | Value | | Components | Value | |
|---------------|-------|-------|---|-------|------|
| | 1990 | 1991 | | 1990 | 1991 |
| Partical size | | | Available nutrients (Kg ha ⁻¹) | | |
| -Course sand | 1 | 1 | -Nitrogen | 179 | 196 |
| -Fine sand | 58 | 57 | -Phosphorus | 22 | 23 |
| -Silt | 25 | 25 | -Potassium | 235 | 233 |
| -Clay | 16 | 17 | pH | 7.2 | 7.0 |
| Total N (%) | 0.042 | 0.046 | Organic Carbon | 0.33 | 0.32 |

Climate:-

Varanasi region is humid subtropical and receives mean annual precipitation of about 1270 mm. Maximum rain in this area is received from July to the end of September. However occasional showers are also very common in June, December and January. The winter months are usually cool and dry. The summer is hot and dry. Western hot wind (locally known as Loo) starts from April and continues till the onset of Monsoon.

Monthly distribution of rainfall, minimum and maximum temperature, mean relative humidity from June 1990 to January 1991 and June 1991 to January 1992 are presented in Table 2 and also depicted in Fig 1. The total rainfall recorded during Kharif season crop period in 1990-91 and 1991-92 from June to January was 1012.06 mm and 991.30 mm. The maximum temperature was 43°C and 40.2°C in first and second years.

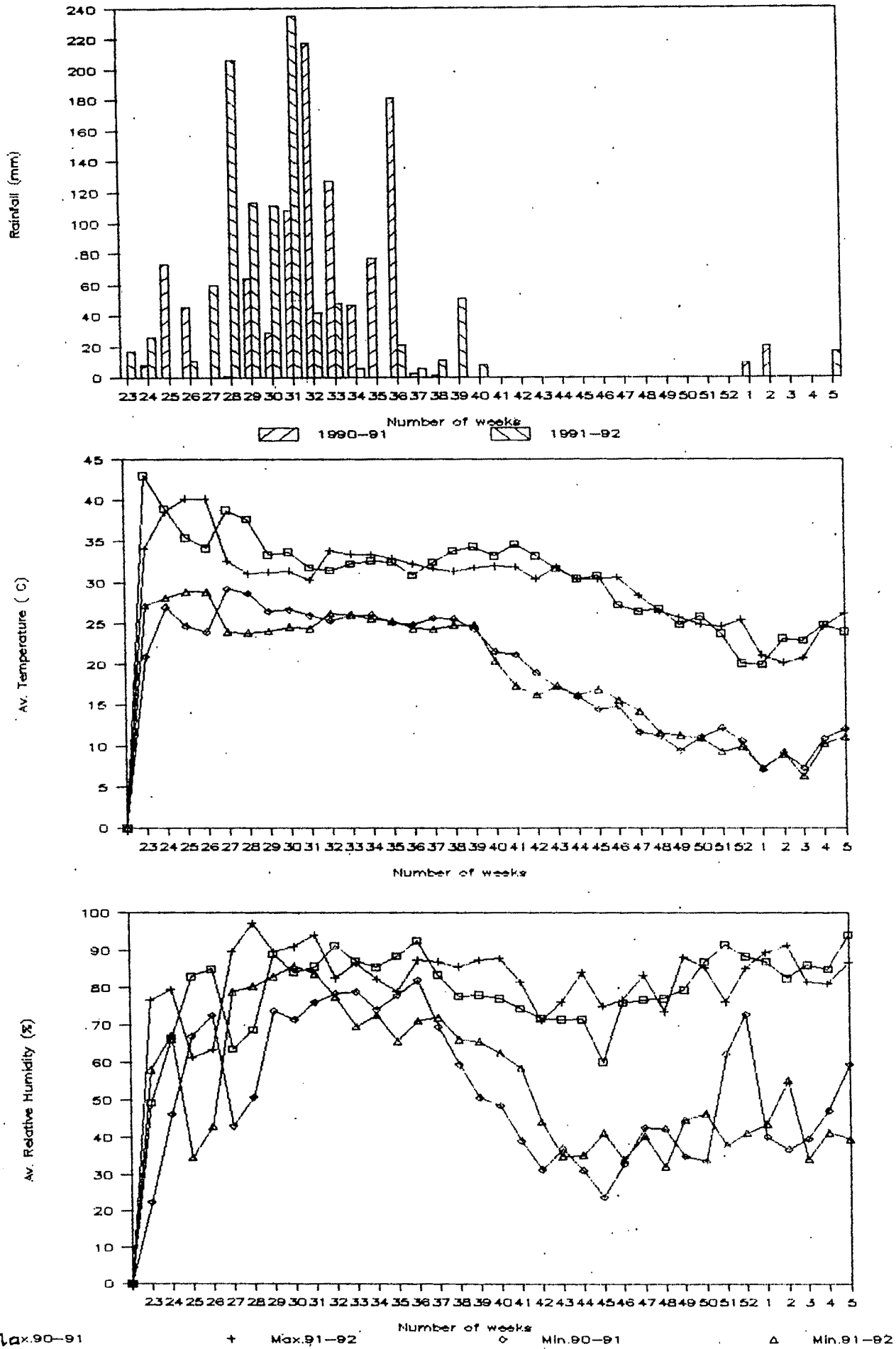
Table 2

Meteorological observations recorded during the period of experimentation at Varanasi.

| Month | Week No. | Rainfall (mm) | | Temperature ($^{\circ}$ C) | | | | Relative Humidity (%) | | | |
|-------|----------|---------------|-------|-----------------------------|-------|---------|-------|-----------------------|-------|---------|-------|
| | | | | Maximum | | Minimum | | Maximum | | Minimum | |
| | | 90-91 | 91-92 | 90-91 | 91-92 | 90-91 | 91-92 | 90-91 | 91-92 | 90-91 | 91-92 |
| June | 23 | 00.0 | 16.9 | 43.0 | 34.1 | 20.9 | 27.2 | 49.1 | 76.5 | 22.4 | 58.0 |
| | 24 | 08.5 | 26.2 | 39.0 | 38.6 | 27.0 | 28.1 | 66.3 | 79.3 | 46.0 | 67.1 |
| | 25 | 73.7 | TRAC | 35.5 | 40.2 | 24.7 | 28.9 | 83.0 | 61.3 | 66.9 | 34.5 |
| July | 26 | 46.0 | 10.8 | 34.2 | 40.2 | 24.0 | 28.9 | 85.0 | 63.3 | 72.5 | 42.9 |
| | 27 | 00.0 | 59.8 | 38.8 | 32.7 | 29.3 | 24.0 | 63.5 | 89.7 | 42.9 | 78.8 |
| | 28 | 00.6 | 206.2 | 37.7 | 31.1 | 28.7 | 23.9 | 68.7 | 97.1 | 50.7 | 80.3 |
| | 29 | 64.0 | 113.1 | 33.4 | 31.3 | 26.5 | 24.1 | 89.0 | 89.7 | 73.7 | 82.9 |
| | 30 | 29.0 | 111.1 | 33.7 | 31.4 | 26.7 | 24.6 | 84.1 | 90.9 | 71.3 | 85.9 |
| Aug. | 31 | 108.0 | 235.2 | 31.8 | 30.3 | 26.0 | 24.4 | 85.7 | 94.1 | 76.0 | 83.7 |
| | 32 | 217.1 | 42.2 | 31.5 | 33.9 | 25.4 | 26.3 | 91.3 | 82.5 | 78.4 | 77.5 |
| | 33 | 127.0 | 48.4 | 32.3 | 33.5 | 26.1 | 26.1 | 87.1 | 86.7 | 78.9 | 69.4 |
| | 34 | 46.9 | 05.8 | 32.7 | 33.4 | 26.1 | 25.6 | 85.5 | 82.3 | 74.0 | 72.5 |
| | 35 | 77.0 | 00.3 | 32.5 | 33.0 | 25.1 | 25.3 | 88.4 | 78.9 | 77.9 | 65.5 |
| Sept. | 36 | 180.6 | 21.0 | 30.9 | 32.3 | 24.9 | 24.4 | 92.5 | 87.3 | 81.9 | 71.0 |
| | 37 | 02.5 | 05.6 | 32.5 | 31.7 | 25.7 | 24.3 | 83.4 | 87.0 | 69.3 | 71.9 |
| | 38 | 1.6 | 11.4 | 33.9 | 31.4 | 25.6 | 24.8 | 77.7 | 85.7 | 59.3 | 66.0 |
| Oct. | 39 | 00.0 | 51.2 | 34.4 | 31.8 | 24.3 | 24.8 | 78.0 | 87.3 | 50.5 | 65.4 |
| | 40 | 00.0 | 08.2 | 33.3 | 32.0 | 21.6 | 20.4 | 77.1 | 88.0 | 48.4 | 62.3 |
| | 41 | 00.0 | TRAC | 34.7 | 31.9 | 21.2 | 17.3 | 74.3 | 81.5 | 39.0 | 58.4 |
| | 42 | 00.0 | 00.0 | 33.3 | 30.5 | 18.9 | 16.2 | 71.7 | 71.0 | 31.3 | 44.0 |
| | 43 | 00.0 | 00.0 | 31.7 | 31.9 | 17.2 | 17.3 | 71.3 | 76.0 | 36.9 | 34.9 |
| Nov. | 44 | 00.0 | 00.0 | 30.5 | 30.5 | 16.0 | 16.2 | 71.4 | 84.0 | 31.0 | 35.1 |
| | 45 | TRAC | 00.0 | 30.9 | 30.5 | 14.5 | 16.9 | 60.0 | 74.9 | 23.7 | 41.0 |
| | 46 | 00.0 | 00.0 | 27.3 | 30.7 | 14.9 | 15.6 | 75.9 | 76.7 | 32.7 | 33.9 |
| | 47 | 00.0 | 00.0 | 26.5 | 28.5 | 11.7 | 14.2 | 76.7 | 83.4 | 42.5 | 40.3 |
| | 48 | 00.0 | 00.0 | 26.8 | 26.5 | 11.2 | 11.6 | 77.0 | 73.5 | 42.1 | 32.0 |
| Dec. | 49 | 00.0 | 00.0 | 24.9 | 25.8 | 9.4 | 11.3 | 79.4 | 88.1 | 34.7 | 44.5 |
| | 50 | 00.0 | 00.0 | 25.9 | 24.9 | 11.1 | 10.9 | 86.9 | 85.4 | 33.4 | 46.1 |
| | 51 | 00.0 | 00.0 | 23.8 | 24.7 | 12.2 | 9.3 | 91.4 | 76.0 | 62.1 | 37.7 |
| Jan. | 52 | 00.0 | 00.9 | 20.1 | 25.5 | 10.6 | 9.9 | 88.3 | 85.1 | 72.7 | 40.9 |
| | 1 | 9.4 | 00.0 | 19.9 | 21.1 | 7.1 | 7.3 | 86.9 | 89.4 | 40.0 | 43.3 |
| | 2 | 20.5 | 00.0 | 23.2 | 20.2 | 9.2 | 9.0 | 82.5 | 91.3 | 36.7 | 55.1 |
| | 3 | 00.0 | 00.0 | 22.9 | 20.7 | 7.3 | 6.3 | 86.0 | 81.5 | 39.4 | 34.0 |
| | 4 | 00.0 | 00.0 | 24.9 | 24.7 | 10.9 | 10.2 | 84.9 | 81.0 | 46.9 | 41.1 |
| | 5 | 00.0 | 17.0 | 24.0 | 26.3 | 12.1 | 11.1 | 94.1 | 86.5 | 59.4 | 39.3 |

The minimum temperature was 7.1° C in first year and 6.3° C in second year. Maximum relative humidity was recorded in July and August in either year.

Fig 1:- Weather revealed during crop period.



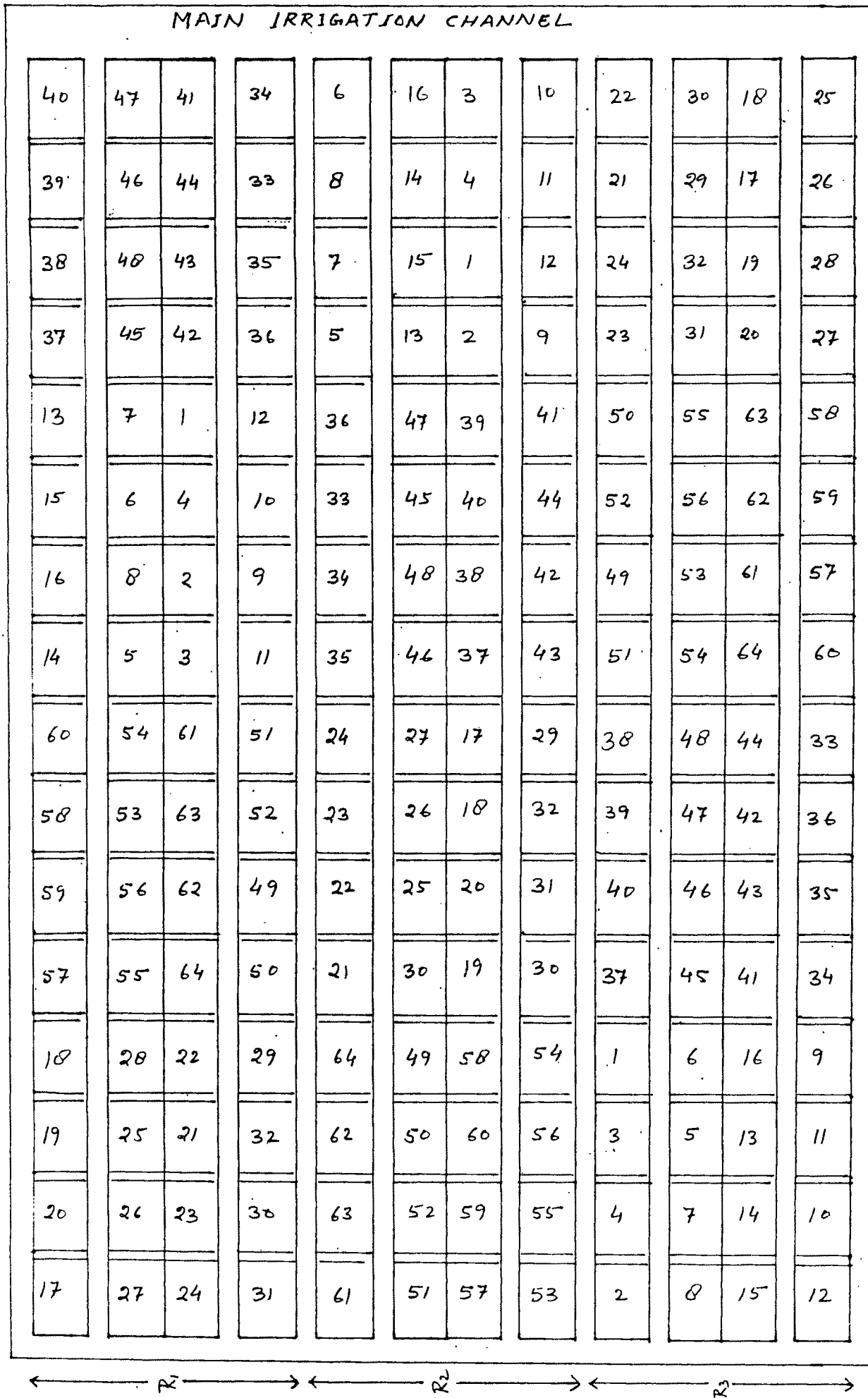
Experimental Materials:-

Onion cultivar N-53 was used for the experiment which produces red, large to small sized and round shaped bulbs. The seeds were shown in nursery beds carefully at the Udai Pratap Autonomous College, Vegetable Research Farm, Varanasi.

Factors and Treatments:-

| S.No. | Factors | Treatments | Notations |
|-------|-----------------------|--|----------------|
| 1. | Date of seed sowing:- | Ist June | D ₁ |
| | | 15th June | D ₂ |
| | | 30th June | D ₃ |
| | | 15th July | D ₄ |
| 2. | Weeding intensity:- | No weeding | W ₀ |
| | | Two weeding at 20 and 40 days after transplanting | W ₁ |
| | | Pendimethalin 1.5 Kg ha ⁻¹ | W ₂ |
| | | Pendimethalin 1.5 Kg ha ⁻¹ +1 hand weeding at 40 days after transplanting | W ₃ |
| 3. | Nitrogen levels:- | 0 Kg Nitrogen ha ⁻¹ | N ₀ |
| | | 80 Kg " " | N ₁ |
| | | 120 Kg " " | N ₂ |
| | | 160 Kg " " | N ₃ |

Fig 2:- Lay Out Plan Of The Experiment



Treatment combinations.

There were 64 (4x4x4) treatment combinations in all as given below:-

| | | | |
|--|--|--|--|
| 1. D ₁ W ₀ N ₀ | 17. D ₂ W ₀ N ₀ | 33. D ₃ W ₀ N ₀ | 49. D ₄ W ₀ N ₀ |
| 2. D ₁ W ₀ N ₁ | 18. D ₂ W ₀ N ₁ | 34. D ₃ W ₀ N ₁ | 50. D ₄ W ₀ N ₁ |
| 3. D ₁ W ₀ N ₂ | 19. D ₂ W ₀ N ₂ | 35. D ₃ W ₀ N ₂ | 51. D ₄ W ₀ N ₂ |
| 4. D ₁ W ₀ N ₃ | 20. D ₂ W ₀ N ₃ | 36. D ₃ W ₀ N ₃ | 52. D ₄ W ₀ N ₃ |
| 5. D ₁ W ₁ N ₀ | 21. D ₂ W ₁ N ₀ | 37. D ₃ W ₁ N ₀ | 53. D ₄ W ₁ N ₀ |
| 6. D ₁ W ₁ N ₁ | 22. D ₂ W ₁ N ₁ | 38. D ₃ W ₁ N ₁ | 54. D ₄ W ₁ N ₁ |
| 7. D ₁ W ₁ N ₂ | 23. D ₂ W ₁ N ₂ | 39. D ₃ W ₁ N ₂ | 55. D ₄ W ₁ N ₂ |
| 8. D ₁ W ₁ N ₃ | 24. D ₂ W ₁ N ₃ | 40. D ₃ W ₁ N ₃ | 56. D ₄ W ₁ N ₃ |
| 9. D ₁ W ₂ N ₀ | 25. D ₂ W ₂ N ₀ | 41. D ₃ W ₂ N ₀ | 57. D ₄ W ₂ N ₀ |
| 10. D ₁ W ₂ N ₁ | 26. D ₂ W ₂ N ₁ | 42. D ₃ W ₂ N ₁ | 58. D ₄ W ₂ N ₁ |
| 11. D ₁ W ₂ N ₂ | 27. D ₂ W ₂ N ₂ | 43. D ₃ W ₂ N ₂ | 59. D ₄ W ₂ N ₂ |
| 12. D ₁ W ₂ N ₃ | 28. D ₂ W ₂ N ₃ | 44. D ₃ W ₂ N ₃ | 60. D ₄ W ₂ N ₃ |
| 13. D ₁ W ₃ N ₀ | 29. D ₂ W ₃ N ₀ | 45. D ₃ W ₃ N ₀ | 61. D ₄ W ₃ N ₀ |
| 14. D ₁ W ₃ N ₁ | 30. D ₂ W ₃ N ₁ | 46. D ₃ W ₃ N ₁ | 62. D ₄ W ₃ N ₁ |
| 15. D ₁ W ₃ N ₂ | 31. D ₂ W ₃ N ₂ | 47. D ₃ W ₃ N ₂ | 63. D ₄ W ₃ N ₂ |
| 16. D ₁ W ₃ N ₃ | 32. D ₂ W ₃ N ₃ | 48. D ₃ W ₃ N ₃ | 64. D ₄ W ₃ N ₃ |

Layout of the Experiment:-

| Design | Split plot Design |
|----------------------------------|-------------------|
| Number of treatment combinations | 64 |
| Number of replications | 3 |
| Total number of plots | 192 |
| Main irrigation channel | 1 M |
| Sub-irrigation channel | Ø.5 M |
| Field border | 1 M |
| Plot border | Ø.3Ø M |

| | |
|-------------------------------------|---------------------|
| Net plot size | 2X3 M = 6 Sq.m |
| Gross plot area | 2.3X3.3 = 7.59 Sq.m |
| Spacing | 15X10 cm |
| Total area of the experimental plot | 1945.4 Sq.m |

Raising of seedlings :-

Treated onion seeds of cultivar N-53 were obtained from Associated Agricultural Development Foundation, Varanasi. The plot for sowing onion seed was ploughed and manured with sieved municipal compost at the rate of 60kg 100 Sq.m⁻¹. Flat beds of 3X1 M each arranged in linear fashion were prepared and levelled thoroughly. About 60 g seed was sown in each bed by broadcast method. After sowing, a thin layer of FYM was given to cover the seeds in the beds. The beds were covered with a mulch of paddy straw on the same day to conserve soil moisture. A light irrigation was done one day after seed sowing. Paddy straw was removed when the seeds germinated completely. After germination the seed bed was drenched with thiram @ 2.5 litre⁻¹ of water at weekly intervals to protect the seedlings from damping-off disease. Regular care of nursery in terms of watering, weeding and plant protection etc. was taken timely.

Preparation of field for transplanting :-

By repeated number of ploughing soil was made to fine tilth and levelled. After levelling the field was divided into beds and channels of suitable size. FYM @ 50 tonnes ha⁻¹ was applied in the beds and mixed well into the soil before one week of transplanting.

Application of fertilizers :-

Beside the application of different nitrogen levels through urea, phosphorus and potash were supplied @ 60 and 100 kg ha⁻¹ through Single Superphosphate and Muriate of Potash, respectively. Half amount of urea and total quantity of Single Superphosphate and Muriate of Potash were incorporated as basal dose in individual plot prior transplanting. The remaining quantity of urea was applied as top-dressing at 30 days after transplanting.

Transplanting :-

Eight week old seedlings were transplanted in rows marked with the help of rake at 15 cm distance. The plant to plant distance of 10 cm was regulated with the help of rope. Only those seedlings which were healthy and showed uniform growth were used for transplanting. The selected seedlings were further given a treatment of pruning to their tops to the extent of 25% and thereafter they were transplanted in well prepared beds. A light irrigation immediately after transplanting and subsequent irrigations were given to the crop at different intervals according to the need of crop.

Application of Herbicide :-

Pendimethalin was used as herbicide during the course of present study. The stock solution of herbicide was diluted with help of tap water and applied @ 1.5 kg as active ingredients ha⁻¹ when needed. It was used in pre-emergence period with the help of Foot Sprayer. Details of herbicide used in the present study are as under :-

Trade name - Stomp (Pendimethalin)

Chemical name - N- (1-ethyl-propyl-3, 4 dimethyl 1-2, 6
dinitrobenzenamine)

Active ingredient (%) - 30

Chemical group - Dinitroanilines.

Crop Studies:-

To study different characters of plants following observations were made.

1. Growth Characters :-

To study the growth characters, five randomly selected plants from each plot were uprooted at four stages of development i.e 30, 60, 90 and 120 days after transplanting. The same plants were brought to the laboratory for the following observations :-

1.1. Height of plants :-

The height (cm) of plant was measured from the base of bulb to the top of the leaf with the help of meter scale.

1.2. Length of leaf :-

The length (cm) of a leaf of the plant from the point of neck to the growing tip was measured by means of a meter scale.

1.3 Number of leaves plants⁻¹ :-

The leaves of the sampled plants were counted and recorded for obtaining average value.

1.4 Fresh weight of leaves plant⁻¹ :-

Fresh weight of all the leaves of each plant was recorded with the help of a physical balance and expressed in terms of grams.

1.5 Dry weight of the leaves plant⁻¹ :-

The dry weight of the leaves was recorded after oven drying at 60°C to a constant weight and expressed in grams.

1.6 Thicknes of neck :-

The thickness (cm) of the neck of bulbs was measured with the help of Vernier Calliper.

1.7 Fresh weight of bulb :-

The fresh weight of bulb was taken with the help of a balance and expressed in grams.

1.8 Dry weight of bulb :-

The dry weight of the bulb was taken after drying in an oven to a constant weight and expressed in grams.

1.9 Diameter of bulb :-

The diameter (cm) of bulb was measured individually with the help of Vernier Calliper at the thickest point.

2. Studies at harvest :-

The crop was harvested when it reached at proper maturity which was judged by the drying and falling of tops. Durings this stage the bulbs were dugout and following observations were recorded at the same time.

2.1 Size of bulb :-

(a) Diameter of bulbs (cm) and (b) Weight of bulbs (kg)

2.2 Yield ($Q\ ha^{-1}$) :-

Bulbs produced from each plot were harvested and weighed separately to determine the yield and it was expressed in terms of $q\ ha^{-1}$.

3. Qualitative studies of bulbs :-

Just after harvesting, four bulbs from each treatment were taken and analysed for the following :-

3.1 Total Soluble Solids (TSS) :-

This was determined by ABBE refractometer and presented in per cent.

3.2 Vitamin 'c' (Ascorbic acid) :-

For the determination of ascorbic acid, 50 g of fresh bulb was taken and crushed. Then it was transferred into a 250 ml beaker and mixed with 6 per cent of metaphosphoric acid. Thirty grams of this mixture was taken in 100 ml volumetric flask and made to volume by adding metaphosphoric acid (3%) and filtered. Now, the filtrate was used for the determination of ascorbic acid by 2,6-dichlorophenol-indophenol dye method (AOAC, 1980). This was expressed in mg 100gm⁻¹ bulb juice.

3.3 Allyl Sulphide :-

The method of Glen and Gilbert (1951) was employed to estimate the allyl sulphide content in onion bulbs. At maturity of onion, samples were collected, chopped into small pieces and 10g of each treatment was preserved in alcohol (70%) separately in glass stoppered bottles for the estimation of allyl sulphide. The stored alcoholic extract was filtered and the filtrate was made to 50 ml in a volumetric flask with 80 per cent ethyl alcohol at the time of estimation of allyl sulphide. A 5 ml of sample equivalent to 1 g of sample material was taken and was made clear by saturated lead acetate. The excess of lead was removed sodium oxalate. The sample was cooled in cold water for 3 minutes and the clear extract was poured off. 5 ml of 80 per cent alcohol and 10 ml of chloroamic acid (gold chloride) (1: 1000) was subsequently added to the clear extract. The mixture was allowed to stand for 10 minutes and the turbidity was determined by measuring the percentage transmission with the help of spectrophotometer. The concentration of allyl sulphide was determined by comparing the readings given by standard allyl sulphide solution treated in the same manner. This was also expressed in mg 100g⁻¹.

4. Storage studies :-

Twenty fully developed and matured bulbs from each treatment were selected and stored in wooden rakes in a well ventilated room. The following observations were recorded after 30 days of storage time.

- (1) Loss in weight of the bulbs.
- (2) Number of bulbs sprouted.

5. Economics of the study :-

The cost of production of bulbs ha₋₁ under the different treatments was calculated on the basis of expenditure incurred different operations done for raising the crop separately under each treatment. Then the net profit was obtained by deducting the cost of production from gross income ha₋₁ for each treatment combination.

6. Statistical analysis :-

The data recorded during the course of investigations in both years, were subjected to statistical analysis of variance in 'Split Plot Design'. The significance of different treatments was judged by the help of 'F' (Variance ratio) test. The difference between the treatment means and their interactions were tested with the help of critical differences (C.D).