

## **1256 Integrated Nutrient Management (INM) for hirsutum cotton under cotton- wheat cropping system in canal command area of North West Rajasthan, India**

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**Abstract:** - A field experiment was conducted on sandy loam soil of Sriganganagar to evaluate the integrated effect of organic manure & inorganic fertilizer on the production of hirsutum cotton under cotton- wheat cropping system during 2003-04, 2004-05 & 2005-06. The soil of experimental field was low in nitrogen, medium in phosphorus & high in available potash. It was laid out in randomized block design with seven treatments replicated thrice. The pooled data of three years revealed that the treatment F<sub>5</sub>, 100 %R.D.F + 25 kg ZnSo<sub>4</sub> /ha + Boron two foliar spray @ 0.1% significantly increased seed cotton yield over F<sub>1</sub>, Absolute control; F<sub>2</sub>, 100 % recommended dose of fertilizer; F<sub>4</sub>, 100 %RDF +Boron two foliar spray @ 0.1 % and F<sub>7</sub>, 25%N through organic +75 % N through fertilizer +PK adjusted to 100 % RD and remained statistically at par with F<sub>3</sub>, 100 %R.D.F +25 kg ZnSo<sub>4</sub>/ha and F<sub>6</sub>, 50 %N through organic +50 % N through fertilizer +PK adjusted to 100 % RD. The higher seed cotton yield under this treatment might be due to higher growth parameters as well as yield attributing characters like number of bolls/plant & boll weight. The results was in close conformity with Blaise and Singh, 2004 and they also reported that the seed cotton yield of hirsutum cotton was significantly increased by the application of zinc sulphate over the recommended dose of fertilizer alone and the per cent increase was 20%.

In view of wheat crop the treatment F<sub>6</sub>, 50 %N through organic + 50% N through fertilizer + PK adjusted to 100 % RD gave significantly higher grain yield (with pooled yield 42.9 q/ha) over F<sub>1</sub>, Absolute control; F<sub>2</sub>, 100 % recommended dose of fertilizer and F<sub>4</sub>, 100 %RDF +Boron two foliar spray @ 0.1 % and remained statistically at par with rest of the treatments. It might be due to residual effect of integration of organic and inorganic fertilizers applied during previous cotton crop, which increased the ancillary characters and ultimately yield. The highest net return of Rs 48330/ha with cost benefit ratio of 3.123 was recorded with F<sub>5</sub>, 100 %R.D.F + 25 kg ZnSo<sub>4</sub>/ha +Boron two foliar spray @ 0.1 % and lowest was in F<sub>1</sub>, absolute control.

**Introduction:** - Cotton (*Gossypium hirsutum* L.) is one of the most important fibre crops of India. But now days, the production of this crop is declining since the advent of high yielding varieties in Canal command area of north-west Rajasthan (**Anonymous 2002-03**). For getting maximum production, farmers are in practice of using more & more chemical fertilizers. Under such a situation, it is essential to evolve and adopt a strategy of integrated nutrient management by using a judicious combination of chemical fertilizers and organic manures which may not only increase production but also improve soil health for sustaining the productivity of hirsutum cotton under cotton-wheat cropping system. Deficiency of zinc has become wide spread due to this reason, response of primary nutrients is not being observed. With the application of zinc sulphate, yield was significantly improved over the recommended dose of fertilizer alone (**Blaise and Singh, 2004**). Keeping in view the above points, the present investigations were initiated.

**Experimental procedure:** - The experiments were conducted during the kharif & rabi seasons of 2003-04, 2004-05 & 2005-06 on sandy loam soil with status of low in nitrogen, medium in phosphorus & high in available potash at the Agricultural Research Station, Rajasthan Agricultural University, Sri Ganganagar, Rajasthan, India. An experiment was laid

out in randomized block design with three replication comprising seven treatments *viz.*, F<sub>1</sub>, Absolute control; F<sub>2</sub>, 100 % recommended dose of fertilizer (80:40:20); F<sub>3</sub>, 100 %R.D.F +25 kg ZnSo<sub>4</sub>/ha; F<sub>4</sub>, 100 %RDF + Boron two foliar spray @ 0.1 %; F<sub>5</sub>, 100 %R.D.F + 25 kg ZnSo<sub>4</sub>/ha + Boron two foliar spray @ 0.1 %; F<sub>6</sub>, 50 %N through organic +50 %N through fertilizer +PK adjusted to 100 %RD and F<sub>7</sub>, 25%N through organic +75 %N through fertilizer + PK adjusted to 100 % RD. The *G. hirsutum* cotton variety RS-2013 was sown by dibbling 2-3 seeds/hill at a spacing of 67.5 x 30 cm in the first fortnight of May during all the crop seasons. Well rotten farmyard manure (FYM) was applied 15-20 days before sowing and different nutrients were applied as per treatments in cotton crop. The data on plant height, boll weight and number of bolls/plant were recorded from randomly selected five plants from each plot and seed cotton yield was recorded on per plot basis. Adequate plant protection measures were taken as per recommendations.

The wheat variety Raj-3077 was sown in the second fortnight of November during all the three crop seasons with a row spacing of 20 cm. Recommended dose of nitrogen (120 kg/ha.) and phosphorus (40 kg/ha.) was applied through urea & DAP in all the treatments. Half dose of nitrogen and full dose of phosphorus were applied as basal and remaining dose of nitrogen was top-dressed at first irrigation.

## **Results and Discussion**

### **Growth parameters**

The data presented in table-1 revealed that treatment F<sub>5</sub>, 100 % R.D.F + 25 kg ZnSo<sub>4</sub>/ha +Boron two foliar spray @ 0.1% significantly increased plant height over F<sub>1</sub>, Absolute control; F<sub>2</sub>, 100 % recommended dose of fertilizer; F<sub>4</sub>, 100 %RDF + Boron two foliar spray at 0.1% and F<sub>7</sub>, 25%N through organic +75 % N through fertilizer +PK adjusted to 100 % RD and remained statistically at par with F<sub>3</sub>, 100 %R.D.F +25 kg ZnSo<sub>4</sub>/ha and F<sub>6</sub>, 50 %N through organic +50 % N through fertilizer +PK adjusted to 100 % RD. Different INM treatments did not influence the number of sympods, monopod branches/plant and plant stand /ha.

### **Yield and yield attributes**

The pooled data in table-2 revealed that treatment F<sub>5</sub>, 100 %R.D.F + 25 kg ZnSo<sub>4</sub>/ha +Boron two foliar spray @ 0.1% significantly increased seed cotton yield over F<sub>1</sub>, Absolute control; F<sub>2</sub>, 100 % recommended dose of fertilizer; F<sub>4</sub>, 100 %RDF + Boron two foliar spray @ 0.1 % and F<sub>7</sub>, 25%N through organic +75 % N through fertilizer +PK adjusted to 100 % RD and remained statistically at par with F<sub>3</sub>, 100 %R.D.F +25 kg ZnSo<sub>4</sub>/ha and F<sub>6</sub>, 50 %N through organic +50 % N through fertilizer +PK adjusted to 100 % RD. The higher seed cotton yield under this treatment might be due to higher growth parameters as well as yield attributing characters like number of bolls/plant, boll weight. Application of Zn increased the seed cotton yield, number of bolls/plant and boll weight consequently in three years in cotton-wheat cropping system (Mathur, 2005). Rattan *et al.* (1997) have also reported the rise in Zn deficiency and he concluded that the response to zinc sulphate ranged from 0 to 0.78 tonnes/ha. Zinc sulphate is now included as a part of the fertilizer recommendation in the most of the part of India.

## **Nutrient uptake**

The data presented in table-3 revealed that treatment F<sub>5</sub>, 100 %R.D.F + 25 kg ZnSO<sub>4</sub>/ha +Boron two foliar spray @ 0.1 % recorded maximum NPK uptake and lowest was recorded in absolute control. The value of N, P and K uptake under this treatment was 119.2, 17.9 and 110.4. N, P and K kg/ha, respectively Fibre quality parameters

Fibre length, Uniformity %, Micronaire value, Strength g/tex, Elongation % and Short Fibre Content % have been recorded but the parameters were not influenced by different treatments (table-4). Similar results have been reported by Blaise *et. al.* 2005 and Mathur and Matish Chandra, 2005.

## **Effect on wheat crop**

### **Growth and yield attributing characters**

The critical examination of data (table-5) revealed that residual effect of treatment F<sub>6</sub>, 50 %N through organic + 50 % N through fertilizer + PK adjusted to 100 % RD significantly increased plant height, effective tillers/metre row length and test weight over F<sub>1</sub>. Absolute control and remained statistically at par with rest of the treatments. Whereas, ear length and number of grains/spike did not influenced significantly with all the treatments.

## **Yield**

On the basis of three years pooled data, presented in table-6 indicated that residual effect of treatment F<sub>6</sub>, 50 %N through organic + 50% N through fertilizer + PK adjusted to 100 % RD gave significantly higher grain yield (with pooled yield 42.9 q/ha) and straw yield over F<sub>1</sub>. Absolute control; F<sub>2</sub>, 100 % recommended dose of fertilizer and F<sub>4</sub>, 100 %RDF +Boron two foliar spray @ 0.1 % and remained statistically at par with rest of the treatments. It might be due to increased ancillary characters and residual effect of integration of organic and inorganic fertilizers applied during previous cotton crop. Integrated nutrient supply is also known to improve water use efficiency and physical condition of soils in respect to structure, granules, friability and porosity and provide balanced nutrient supply to the crop (Das, 1996).

## **Nutrient uptake**

The data of pooled analysis of nutrients uptake (NPK) presented in table -7 revealed that treatment F<sub>6</sub>, 50 %N through organic +50 % N through fertilizer +PK adjusted to 100 % RD was found significantly superior over F<sub>1</sub>, absolute control and it was at par with F<sub>7</sub>, 25%N through organic +75 % N through fertilizer +PK adjusted to 100 % RD in respect of N & at par with rest of the treatments in respect of P<sub>2</sub>O<sub>5</sub> and at par with F<sub>3</sub>, 100 %R.D.F +25 kg ZnSO<sub>4</sub>/ha; F<sub>5</sub>, 100 %R.D.F + 25 kg ZnSO<sub>4</sub>/ha + Boron two foliar spray @ 0.1 % and F<sub>7</sub> in respect of K<sub>2</sub>O.

## **Economics**

The gross return, net return & cost benefit ratio of the total crop sequence was also recorded and data reveals that highest net return of Rs 48330/ha with cost benefit ratio of 3.123 recorded with F<sub>5</sub>, 100 %R.D.F + 25 kg ZnSO<sub>4</sub>/ha + Boron two foliar spray @ 0.1 %

closely followed by F<sub>6</sub>, 50 %N through organic +50 % N through fertilizer +PK adjusted to 100 % RD and F<sub>3</sub>, 100 %R.D.F +25 kg ZnSo<sub>4</sub>/ha and lowest was in F<sub>1</sub>, absolute control (Table 8).

## Conclusion

On the basis of three years pooled data it is concluded that treatment F<sub>5</sub>, 100 %R.D.F + 25 kg ZnSo<sub>4</sub>/ha + Boron two foliar spray @ 0.1 % would be better for getting higher yield as well as net monetary returns/ha in canal command area of north west Rajasthan, India.

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Table. 2. Effect of integrated nutrient management on yield and yield attributing characters of *hirsutum* cotton

| Treatments   | Seed cotton yield (q/ha) |       |       |        | No. of bolls/plant |       |       | Boll Weight (g) |       |       |
|--|--------------------------|-------|-------|--------|--------------------|-------|-------|-----------------|-------|-------|
|  | 03-04                    | 04-05 | 05-06 | Pooled | 03-04              | 04-05 | 05-06 | 03-04           | 04-05 | 05-06 |
| F <sub>1</sub> - Absolute control  | 9.42                     | 16.98 | 11.07 | 12.49  | 18.27              | 20.30 | 28.7  | 2.00            | 2.00  | 1.95  |
| F <sub>2</sub> -100 % Recommended Dose of Fertilizer                                 | 11.93                    | 21.48 | 13.77 | 15.73  | 25.00              | 29.67 | 37.3  | 2.25            | 2.25  | 2.15  |
| F <sub>3</sub> - 100 %R.D.F +25 kg ZnSO <sub>4</sub> /ha                             | 14.09                    | 26.14 | 16.62 | 18.95  | 31.00              | 35.70 | 46.0  | 2.45            | 2.49  | 2.38  |
| F <sub>4</sub> - 100 %RDF +Boron two foliar spray @ 0.1%.                            | 12.43                    | 22.26 | 14.12 | 16.27  | 26.33              | 30.20 | 39.7  | 2.32            | 2.27  | 2.18  |
| F <sub>5</sub> -100 %R.D.F+25kg Zn So <sub>4</sub> /ha+Boron two foliar spray @ 0.1% | 14.50                    | 27.26 | 17.65 | 19.80  | 32.33              | 38.50 | 48.3  | 2.50            | 2.62  | 2.53  |
| F <sub>6</sub> -50 %N organic +50 % N through fertilizer +PK adjusted to 100 % RD.   | 13.11                    | 25.80 | 15.92 | 18.28  | 26.93              | 35.30 | 46.7  | 2.36            | 2.54  | 2.35  |
| F <sub>7</sub> - 25%N organic +75 % N through fertilizer +PK adjusted to 100 % RD.   | 12.20                    | 23.76 | 15.25 | 17.07  | 25.47              | 29.70 | 39.0  | 2.28            | 2.41  | 2.25  |
| CD. at 5%  | 2.01                     | 3.14  | 2.29  | 2.35   | 5.65               | 3.58  | 7.5   | 0.17            | 0.20  | 0.18  |

**Table3. Effect of integrated nutrient management on nutrient uptake kg/ ha in cotton.**

| Treatments  | N uptake kg/ha. |       |       | P <sub>2</sub> O <sub>5</sub> uptake kg/ha. |       |       | K <sub>2</sub> O uptake kg/ha. |       |       | Pooled uptake kg/ha. |                               |                  |
|---|-----------------|-------|-------|---|-------|-------|--------------------------------|-------|-------|----------------------|-------------------------------|------------------|
|   | 03-04           | 04-05 | 05-06 | 03-04                                       | 04-05 | 05-06 | 03-04                          | 04-05 | 05-06 | N                    | P <sub>2</sub> O <sub>5</sub> | K <sub>2</sub> O |
| F <sub>1</sub> - Absolute control   | 53.4            | 63.3  | 53.5  | 6.6   | 7.7   | 12.4  | 45.2                           | 69.4  | 62.0  | 56.7                 | 8.9                           | 58.9             |
| F <sub>2</sub> - 100 % recommended dose of fertilizer                                       | 78.3            | 89.2  | 79.5  | 10.2  | 10.3  | 18.4  | 85.5                           | 90.7  | 73.6  | 82.3                 | 13.0                          | 83.3             |
| F <sub>3</sub> - 100 %R.D.F +25 kg ZnSo <sub>4</sub> /ha                                    | 104.6           | 110.0 | 113.4 | 13.7  | 13.4  | 18.9  | 105.7                          | 103.3 | 83.6  | 109.3                | 15.3                          | 97.5             |
| F <sub>4</sub> - 100 %RDF +Boron two foliar spray @ 0.1 %                                   | 82.3            | 97.2  | 101.9 | 11.2  | 12.6  | 17.6  | 90.6                           | 94.7  | 83.0  | 93.8                 | 13.8                          | 89.4             |
| F <sub>5</sub> -100 %R.D.F + 25 kg ZnSo <sub>4</sub> /ha +Boron two foliar spray @ 0.1 %    | 109.5           | 117.3 | 130.9 | 14.7  | 14.3  | 24.6  | 113.2                          | 107.7 | 110.3 | 119.2                | 17.9                          | 110.4            |
| F <sub>6</sub> - 50 %N through organic +50 % N through fertilizer +PK adjusted to 100 % RD. | 97.5            | 107.3 | 92.0  | 12.5  | 13.9  | 20.0  | 96.6                           | 105.3 | 100.6 | 98.9                 | 15.4                          | 100.8            |
| F <sub>7</sub> - 25%N through organic +75 % N through fertilizer +PK adjusted to 100 % RD.  | 81.4            | 93.4  | 85.0  | 10.8  | 12.8  | 20.2  | 89.4                           | 96.0  | 84.3  | 86.6                 | 14.6                          | 89.9             |
| CD at 5%  | 13.15           | 10.37 | 11.40 | 1.47  | 2.36  | 3.80  | 11.25                          | 10.33 | 10.10 | 11.64                | 2.54                          | 10.56            |





Table 5. Effect of integrated nutrient management on growth and yield attributing characters of wheat under cotton-wheat cropping system.

| Treatments  | Plant height (cm) |       |       | Effective tillers/<br>metre row length |       |       | Ear length (cm) |       |       | No. of grains /spike |       |       |
|---|-------------------|-------|-------|--|-------|-------|-----------------|-------|-------|----------------------|-------|-------|
|   | 03-04             | 04-05 | 05-06 | 03-04                                  | 04-05 | 05-06 | 03-04           | 04-05 | 05-06 | 03-04                | 04-05 | 05-06 |
| F1 - Absolute control   | 94.0              | 77.5  | 86.3  | 69.7                                   | 44.3  | 64.0  | 10.5            | 9.7   | 9.0   | 44.1                 | 28.6  | 45.0  |
| F2 - 100 % recommended dose of fertilizer                                       | 96.1              | 92.4  | 94.7  | 76.0                                   | 53.3  | 76.3  | 10.9            | 10.2  | 9.5   | 46.3                 | 37.6  | 46.1  |
| F3 - 100 %R.D.F +25 kg ZnSo4 /ha  | 98.9              | 88.9  | 96.7  | 74.0                                   | 54.3  | 83.0  | 10.6            | 9.6   | 9.6   | 50.40                | 38.9  | 49.9  |
| F4 - 100 %RDF +Boron two foliar spray @ 0.1 %                                   | 97.1              | 86.7  | 95.0  | 70.3                                   | 55.0  | 77.0  | 10.9            | 10.8  | 9.5   | 47.93                | 37.3  | 47.2  |
| F5 -100 %R.D.F + 25 kg ZnSo4/ha +Boron two foliar spray @ 0.1 %                 | 99.8              | 92.2  | 96.0  | 75.0                                   | 56.3  | 82.0  | 10.9            | 10.1  | 9.6   | 50.7                 | 41.2  | 50.3  |
| F6 - 50 %N through organic +50 % N through fertilizer +PK adjusted to 100 % RD. | 103.3             | 94.6  | 101.0 | 79.0                                   | 58.3  | 89.0  | 11.2            | 10.5  | 10.0  | 52.5                 | 42.6  | 51.2  |
| F7 - 25%N through organic +75 % N through fertilizer +PK adjusted to 100 % RD.  | 100.3             | 91.8  | 98.0  | 71.0                                   | 55.6  | 85.0  | 10.7            | 9.9   | 9.8   | 51.2                 | 39.3  | 50.9  |
| CD at 5%  | 9.11              | 9.3   | 6.19  | 9.10                                   | 7.8   | 8.81  | NS              | NS    | NS    | 7.67                 | 6.8   | NS    |

**Table 6. Effect of integrated nutrient management on yield of wheat under cotton-wheat cropping system**

| Treatments   | Grain yield (q/ha) |       |       |        | Straw yield q/ha. |       |       | Test weight (g) |       |       |
|--|--------------------|-------|-------|--------|-------------------|-------|-------|-----------------|-------|-------|
|  | 03-04              | 04-05 | 05-06 | Pooled | 03-04             | 04-05 | 05-06 | 03-04           | 04-05 | 05-06 |
| F <sub>1</sub> - Absolute control  | 40.0               | 32.7  | 30.3  | 34.3   | 55.9              | 34.7  | 46.3  | 40.8            | 40.6  | 40.8  |
| F <sub>2</sub> -100 % Recommended Dose of Fertilizer                                 | 45.9               | 39.3  | 33.9  | 39.7   | 60.93             | 47.5  | 53.0  | 41.7            | 42.5  | 41.7  |
| F <sub>3</sub> - 100 %R.D.F +25 kg ZnSo <sub>4</sub> /ha                             | 48.0               | 38.4  | 34.4  | 40.3   | 62.2              | 46.3  | 54.1  | 42.4            | 42.9  | 42.4  |
| F <sub>4</sub> - 100 %RDF +Boron two foliar spray @ 0.1%.                            | 46.6               | 38.1  | 34.2  | 39.6   | 60.9              | 46.6  | 53.3  | 42.2            | 40.9  | 41.8  |
| F <sub>5</sub> -100 %R.D.F+25kg Zn So <sub>4</sub> /ha+Boron two foliar spray @ 0.1% | 47.5               | 39.5  | 34.8  | 40.6   | 61.6              | 48.6  | 54.0  | 43.6            | 41.5  | 42.9  |
| F <sub>6</sub> -50 %N organic +50 % N through fertilizer +PK adjusted to 100 % RD.   | 48.6               | 43.0  | 37.2  | 42.9   | 63.0              | 51.6  | 56.8  | 43.8            | 42.6  | 43.1  |
| F <sub>7</sub> - 25%N organic +75 % N through fertilizer +PK adjusted to 100 % RD.   | 47.8               | 40.0  | 36.0  | 41.3   | 62.4              | 48.3  | 55.6  | 43.3            | 41.2  | 43.0  |
| CD. at 5%  | 8.1                | 5.3   | 3.68  | 2.76   | 6.54              | 8.7   | 5.68  | 3.38            | NS    | 1.40  |

**Table 7. Effect of integrated nutrient management on nutrient uptake kg/ ha in wheat**

| Treatments  | N uptake kg/ha. |       |       | P <sub>2</sub> O <sub>5</sub> uptake kg/ha. |       |       | K <sub>2</sub> O uptake kg/ha. |       |       | Pooled uptake kg/ha. |                               |                  |
|---|-----------------|-------|-------|---|-------|-------|--------------------------------|-------|-------|----------------------|-------------------------------|------------------|
|   | 03-04           | 04-05 | 05-06 | 03-04                                       | 04-05 | 05-06 | 03-04                          | 04-05 | 05-06 | N                    | P <sub>2</sub> O <sub>5</sub> | K <sub>2</sub> O |
| F <sub>1</sub> - Absolute control   | 88.04           | 65.7  | 43.16 | 19.76                                       | 14.4  | 16.68 | 96.65                          | 63.4  | 64.0  | 65.63                | 16.95                         | 74.68            |
| F <sub>2</sub> - 100 % recommended dose of fertilizer                                       | 103.33          | 87.5  | 54.35 | 23.52                                       | 19.7  | 19.67 | 107.57                         | 87.1  | 71.60 | 81.73                | 20.96                         | 88.76            |
| F <sub>3</sub> - 100 %R.D.F +25 kg ZnSO <sub>4</sub> /ha                                    | 109.13          | 84.7  | 58.81 | 24.85                                       | 19.0  | 18.31 | 112.6                          | 86.2  | 71.73 | 84.21                | 20.70                         | 90.18            |
| F <sub>4</sub> - 100 %RDF +Boron two foliar spray @ 0.1 %                                   | 105.16          | 86.5  | 54.38 | 24.00                                       | 18.8  | 19.65 | 110.66                         | 86.2  | 72.04 | 82.01                | 20.82                         | 89.63            |
| F <sub>5</sub> -100 %R.D.F + 25 kg ZnSO <sub>4</sub> /ha +Boron two foliar spray @ 0.1 %    | 110.90          | 91.4  | 58.09 | 24.96                                       | 20.5  | 19.18 | 113.22                         | 90.9  | 72.55 | 86.80                | 21.55                         | 92.22            |
| F <sub>6</sub> - 50 %N through organic +50 % N through fertilizer +PK adjusted to 100 % RD. | 117.00          | 104.6 | 63.78 | 27.21                                       | 24.0  | 20.97 | 116.96                         | 98.2  | 78.89 | 95.13                | 24.06                         | 98.02            |
| F <sub>7</sub> - 25%N through organic +75 % N through fertilizer +PK adjusted to 100 % RD.  | 114.00          | 93.7  | 58.40 | 26.53                                       | 22.0  | 18.99 | 114.46                         | 91.3  | 75.62 | 88.70                | 22.51                         | 93.79            |
| CD at 5%  | 14.03           | 9.1   | 6.74  | 7.24  | 2.8   | NS    | 10.40                          | 16.0  | 7.84  | 6.74                 | 4.49                          | 7.87             |

**Table 8: Effect of integrated nutrient management on gross return(Rs/ha), net return(Rs/ha),cost of cultivation(Rs/ha) & cost benefit ratio of cotton wheat crop sequence.**

| <b>Treatments</b>   | <b>Gross return Rs/ha</b> | <b>Cost of cultivation Rs/ha</b> | <b>Net return Rs/ha</b> | <b>B:C Ratio</b> |
|---|---------------------------|----------------------------------|-------------------------|------------------|
| F <sub>1</sub> - Absolute control   | 52549                     | 18520                            | 34029                   | 2.837            |
| F <sub>2</sub> - 100 % recommended dose of fertilizer                                       | 63188                     | 21075                            | 42113                   | 2.998            |
| F <sub>3</sub> - 100 %R.D.F +25 kg ZnSO <sub>4</sub> /ha                                    | 69328                     | 22230                            | 47101                   | 3.119            |
| F <sub>4</sub> - 100 %RDF +Bfoliar spray @ 0.1 %  | 64124                     | 21535                            | 42589                   | 2.978            |
| F <sub>5</sub> -100 %R.D.F + 25 kg ZnSO <sub>4</sub> /ha +B foliar spray @ 0.1 %            | 71095                     | 22765                            | 48330                   | 3.123            |
| F <sub>6</sub> - 50 %N through organic +50 % N through fertilizer +PK adjusted to 100 % RD. | 70232                     | 22995                            | 47237                   | 3.054            |
| F <sub>7</sub> - 25%N through organic +75 % N through fertilizer +PK adjusted to 100 % RD.  | 66707                     | 21995                            | 44712                   | 3.033            |