



# Evaluate the Effect of Zinc and Iron on Growth, Yield and Quality of Chickpea

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## **Authors' contributions**

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## **ABSTRACT**

The research was lead at the Soil Science Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P. during the *Rabi* season in 2020-21 and 2021-22. The experiment was laid out in Randomized Block Design with sixteen treatments and three replications with four levels of zinc and iron respectively with NPK as an RDF. All plant parameters *i. e.* plant height, number of branches plant<sup>-1</sup>, number of pods plant<sup>-1</sup>, number of seeds pod<sup>-1</sup>, test weight, protein, grain yield and stover yield were found to be significant at C.D @ 5% and best in treatment T<sub>16</sub> (RDF @ 100% + Zinc @ 20 kg ha<sup>-1</sup> + Iron @ 7.5 kg ha<sup>-1</sup>) as compare with in treatment T<sub>1</sub> [Absolute control (RDF @ 0% + Zinc @ 0 kg ha<sup>-1</sup> + Iron @ 0 kg ha<sup>-1</sup>)].

**Keywords:** Zinc; iron; chickpea; plant parameters.

## **1. INTRODUCTION**

Chickpea pea (*Cicer arietinum* L.) is the most important ancient pulse crop that naturally grown during rabi in India and cultivated mainly in semi-

arid and warm world temperate regions where the temperature is 20-30° C [1]. Chickpea belongs to the Leguminosae family. In nearly 50 countries, more than 90 % of chickpea production coming from Asia [2]. Chickpea is

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very valuable, a good source of the protein and has an essential role in the human diet in developing countries. It contains 22.25 percent protein is three times more than that of cereals.

Chickpea is the highest protein-yielding grain legume. The crop can fix 140 kg N ha<sup>-1</sup> in a growing season [3]. 100 g of chickpea seeds provide 360 calories of energy, 5.2 g of fat, 2.2 g of minerals, and 55 g of carbohydrates. The malic and oxalic acid present in green leaves can to minimize intestinal disorders [4]. It is also rich in Ca, Fe, niacin, vitamin B, and vitamin- C. Its leaves contain malic acid indicated for stomach ailments and blood purification. It being a pulse crop enriches the soil through symbiotic nitrogen fixation [5].

Significant increases in seed yield of chickpea by Zn application were demonstrated [6]. Usually, each tone of chickpea seed yield removes 38 g of Zn from the soil [7]. Among micronutrients, Zn deficiency seems to be the most widespread [8]. Zn deficiency is scattered among chickpea-growing regions of the world because chickpea is generally considered sensitive to Zn deficiency [9]. Iron is a structural component of porphyrin molecules, cytochromes, heme, nonheme, ferrichrome, and leghaemoglobin. These substances are involved in oxidation-reduction reactions in respiration and photosynthesis [10].  
Materials and Methods

A field experiment conducted at the Soil Science Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, during the *Rabi* season of two years (2020-21 and 2021-22) growing chickpea *Var.* Sadabahar applied 4 levels of zinc and iron respectively Zinc = 0 kg ha<sup>-1</sup>, 6.67 kg ha<sup>-1</sup>, 13.34 kg ha<sup>-1</sup>, 20 kg ha<sup>-1</sup> and Iron = 0 kg ha<sup>-1</sup>, 2.5 kg ha<sup>-1</sup>, 5 kg ha<sup>-1</sup>, 7.5 kg ha<sup>-1</sup> including RDF for cluster bean = 20:40:20 kg ha<sup>-1</sup> experiment is lead to observe the plant parameters like that plant height, number of branches plant<sup>-1</sup>, number of pods plant<sup>-1</sup>, number of seeds pod<sup>-1</sup>, test weight, protein, grain yield and stover yield.

## 2. RESULTS AND DISCUSSION

A critical perusal of data pertaining in the Table 1 and Fig. 1 the effect of different levels of Zn and Fe plant height (cm) at different days interval of chickpea in both the years (2020-21 and 2021-22) was found to be significant at C.D @ 5%. The plant height of chickpea was found to be maximum 14.92 cm, 30.14 cm, 38.49 cm and 54.28 cm at 30 DAS, 60 DAS, 90 DAS and at

harvest in 2020-21 and 14.96 cm, 30.47 cm, 39.07 cm and 55.09 cm at 30 DAS, 60 DAS, 90 DAS and at harvest in 2021-22 in treatment T<sub>16</sub> (RDF @ 100% + Zinc @ 20 kg ha<sup>-1</sup> + Iron @ 7.5 kg ha<sup>-1</sup>) and minimum 12.54 cm, 25.33 cm, 32.35 cm and 45.62 cm at 30 DAS, 60 DAS, 90 DAS and at harvest in 2020-21 and 12.58 cm, 25.61 cm, 32.84 cm and 46.30 cm at 30 DAS, 60 DAS, 90 DAS and at harvest in 2021-22 in treatment T<sub>1</sub> [Absolute control (RDF @ 0% + Zinc @ 0 kg ha<sup>-1</sup> + Iron @ 0 kg ha<sup>-1</sup>)] respectively [11,12].

A critical perusal of data pertaining in the Table 2 and Fig. 2 the effect of different levels of Zn and Fe on plant of chickpea in both the years (2020-21 and 2021-22) was found to be significant at C.D @ 5%. The number of branches plant<sup>-1</sup> of chickpea was found to be maximum 14.32 in 2020-21 and 14.54 in 2021-22 in treatment T<sub>16</sub> (RDF @ 100% + Zinc @ 20 kg ha<sup>-1</sup> + Iron @ 7.5 kg ha<sup>-1</sup>) followed by 14.25 in 2020-21 and 14.46 in 2021-22 in treatment T<sub>15</sub> (RDF @ 100% + Zinc @ 20 kg ha<sup>-1</sup> + Iron @ 5 kg ha<sup>-1</sup>) and minimum 12.04 in 2020-21 and 12.22 in 2021-22 in treatment T<sub>1</sub> [Absolute control (RDF @ 0% + Zinc @ 0 kg ha<sup>-1</sup> + Iron @ 0 kg ha<sup>-1</sup>)] respectively. The number of pods plant<sup>-1</sup> of chickpea was found to be maximum 115.07 in 2020-21 and 116.79 in 2021-22 in treatment T<sub>16</sub> (RDF @ 100% + Zinc @ 20 kg ha<sup>-1</sup> + Iron @ 7.5 kg ha<sup>-1</sup>) followed by 114.45 in 2020-21 and 116.16 in 2021-22 in treatment T<sub>15</sub> (RDF @ 100% + Zinc @ 20 kg ha<sup>-1</sup> + Iron @ 5 kg ha<sup>-1</sup>) and minimum 85.74 in 2020-21 and 87.03 in 2021-22 in treatment T<sub>1</sub> [Absolute control (RDF @ 0% + Zinc @ 0 kg ha<sup>-1</sup> + Iron @ 0 kg ha<sup>-1</sup>)] respectively [13,14].

The number of seeds pod<sup>-1</sup> of chickpea was found to be maximum 2.18 in 2020-21 and 2.21 in 2021-22 in treatment T<sub>16</sub> (RDF @ 100% + Zinc @ 20 kg ha<sup>-1</sup> + Iron @ 7.5 kg ha<sup>-1</sup>) followed by 2.17 in 2020-21 and 2.20 in 2021-22 in treatment T<sub>15</sub> (RDF @ 100% + Zinc @ 20 kg ha<sup>-1</sup> + Iron @ 5 kg ha<sup>-1</sup>) and minimum 1.83 in 2020-21 and 1.86 in 2021-22 in treatment T<sub>1</sub> [Absolute control (RDF @ 0% + Zinc @ 0 kg ha<sup>-1</sup> + Iron @ 0 kg ha<sup>-1</sup>)] respectively. The test weight of 1000 seeds (g) of chickpea were found to be maximum 129.18 g in 2020-21 and 131.11 g in 2021-22 in treatment T<sub>16</sub> (RDF @ 100% + Zinc @ 20 kg ha<sup>-1</sup> + Iron @ 7.5 kg ha<sup>-1</sup>) followed by 128.48 g in 2020-21 and 130.41 g in 2021-22 in treatment T<sub>15</sub> (RDF @ 100% + Zinc @ 20 kg ha<sup>-1</sup> + Iron @ 5 kg ha<sup>-1</sup>) and minimum 108.57 g in 2020-21 and 110.20 g in 2021-22 in treatment T<sub>1</sub> [Absolute control (RDF @ 0% + Zinc @ 0 kg ha<sup>-1</sup> + Iron @ 0 kg ha<sup>-1</sup>)] respectively [15,16].

**Table 1. Effect of different levels of zinc and iron on plant height (cm) at different days interval of chickpea**

| Treatments      | Plant height (cm) |        |        |            |         |        |        |            |
|-----------------|-------------------|--------|--------|------------|---------|--------|--------|------------|
|                 | 2020-21           |        |        |            | 2021-22 |        |        |            |
|                 | 30 DAS            | 60 DAS | 90 DAS | At harvest | 30 DAS  | 60 DAS | 90 DAS | At harvest |
| T <sub>1</sub>  | 12.54             | 25.33  | 32.35  | 45.62      | 12.58   | 25.61  | 32.84  | 46.30      |
| T <sub>2</sub>  | 13.18             | 26.62  | 34.00  | 47.95      | 13.22   | 26.92  | 34.51  | 48.67      |
| T <sub>3</sub>  | 12.65             | 25.55  | 32.64  | 46.02      | 12.69   | 25.83  | 33.13  | 46.71      |
| T <sub>4</sub>  | 12.82             | 25.90  | 33.08  | 46.64      | 12.86   | 26.18  | 33.57  | 47.34      |
| T <sub>5</sub>  | 13.35             | 26.97  | 34.44  | 48.56      | 13.39   | 27.26  | 34.96  | 49.29      |
| T <sub>6</sub>  | 13.51             | 27.29  | 34.86  | 49.15      | 13.55   | 27.59  | 35.38  | 49.88      |
| T <sub>7</sub>  | 13.92             | 28.12  | 35.91  | 50.64      | 13.96   | 28.43  | 36.45  | 51.40      |
| T <sub>8</sub>  | 13.85             | 27.98  | 35.73  | 50.38      | 13.89   | 28.28  | 36.27  | 51.14      |
| T <sub>9</sub>  | 13.77             | 27.82  | 35.53  | 50.09      | 13.81   | 28.12  | 36.06  | 50.84      |
| T <sub>10</sub> | 14.29             | 28.87  | 36.87  | 51.98      | 14.33   | 29.18  | 37.42  | 52.76      |
| T <sub>11</sub> | 14.04             | 28.36  | 36.22  | 51.07      | 14.08   | 28.67  | 36.77  | 51.84      |
| T <sub>12</sub> | 14.43             | 29.15  | 37.23  | 52.49      | 14.47   | 29.47  | 37.79  | 53.28      |
| T <sub>13</sub> | 14.76             | 29.82  | 38.08  | 53.69      | 14.80   | 30.14  | 38.65  | 54.50      |
| T <sub>14</sub> | 14.51             | 29.31  | 37.44  | 52.78      | 14.55   | 29.63  | 38.00  | 53.58      |
| T <sub>15</sub> | 14.84             | 29.98  | 38.29  | 53.98      | 14.88   | 30.31  | 38.86  | 54.79      |
| T <sub>16</sub> | 14.92             | 30.14  | 38.49  | 54.28      | 14.96   | 30.47  | 39.07  | 55.09      |
| F - test        | S                 | S      | S      | S          | S       | S      | S      | S          |
| CD @ 5%         | 0.60              | 1.20   | 1.50   | 1.77       | 0.59    | 1.17   | 1.71   | 1.88       |
| S.Ed. (±)       | 0.30              | 0.59   | 0.79   | 0.87       | 0.29    | 0.57   | 0.84   | 0.92       |

**Table 2. Effect of different levels of zinc and iron on number of branches plant<sup>-1</sup>, number of pods plant<sup>-1</sup>, number of seeds pod<sup>-1</sup>, test weight of 1000 seeds (g) and protein (%) of chickpea**

| Treatments      | Number of Branches Plant <sup>-1</sup> |         | Number of Pods Plant <sup>-1</sup> |         | Number of Seeds Pod <sup>-1</sup> |         | Test Weight of 1000 seeds (g) |         | Protein (%) |         |
|-----------------|--|---------|------------------------------------|---------|-----------------------------------|---------|-------------------------------|---------|-------------|---------|
|                 | 2020-21                                | 2021-22 | 2020-21                            | 2021-22 | 2020-21                           | 2021-22 | 2020-21                       | 2021-22 | 2020-21     | 2021-22 |
| T <sub>1</sub>  | 12.04                                  | 12.22   | 85.74                              | 87.03   | 1.83                              | 1.86    | 108.57                        | 110.20  | 19.43       | 19.82   |
| T <sub>2</sub>  | 12.65                                  | 12.84   | 101.65                             | 103.17  | 1.92                              | 1.95    | 114.11                        | 115.82  | 20.45       | 20.86   |
| T <sub>3</sub>  | 12.14                                  | 12.33   | 97.56                              | 99.02   | 1.85                              | 1.87    | 109.52                        | 111.17  | 19.78       | 20.18   |
| T <sub>4</sub>  | 12.31                                  | 12.49   | 98.87                              | 100.35  | 1.87                              | 1.90    | 111.00                        | 112.66  | 20.25       | 20.66   |
| T <sub>5</sub>  | 12.82                                  | 13.01   | 102.96                             | 104.50  | 1.95                              | 1.98    | 115.58                        | 117.32  | 20.95       | 21.37   |
| T <sub>6</sub>  | 12.97                                  | 13.16   | 104.19                             | 105.75  | 1.97                              | 2.00    | 116.97                        | 118.72  | 21.1        | 21.52   |
| T <sub>7</sub>  | 13.36                                  | 13.56   | 107.35                             | 108.96  | 2.03                              | 2.06    | 120.52                        | 122.33  | 22.04       | 22.48   |
| T <sub>8</sub>  | 13.30                                  | 13.50   | 106.81                             | 108.42  | 2.02                              | 2.05    | 119.91                        | 121.71  | 21.86       | 22.30   |
| T <sub>9</sub>  | 13.22                                  | 13.42   | 106.20                             | 107.79  | 2.01                              | 2.04    | 119.22                        | 121.01  | 21.54       | 21.97   |
| T <sub>10</sub> | 13.72                                  | 13.92   | 110.21                             | 111.86  | 2.09                              | 2.12    | 123.72                        | 125.58  | 22.31       | 22.76   |
| T <sub>11</sub> | 13.48                                  | 13.68   | 108.28                             | 109.90  | 2.05                              | 2.08    | 121.56                        | 123.38  | 22.18       | 22.62   |
| T <sub>12</sub> | 13.85                                  | 14.06   | 111.29                             | 112.96  | 2.11                              | 2.14    | 124.93                        | 126.81  | 23.34       | 23.81   |
| T <sub>13</sub> | 14.17                                  | 14.38   | 113.83                             | 115.54  | 2.15                              | 2.19    | 127.79                        | 129.71  | 22.67       | 23.12   |
| T <sub>14</sub> | 13.93                                  | 14.14   | 111.90                             | 113.58  | 2.12                              | 2.15    | 125.63                        | 127.51  | 22.84       | 23.30   |
| T <sub>15</sub> | 14.25                                  | 14.46   | 114.45                             | 116.16  | 2.17                              | 2.20    | 128.48                        | 130.41  | 23.76       | 24.24   |
| T <sub>16</sub> | 14.32                                  | 14.54   | 115.07                             | 116.79  | 2.18                              | 2.21    | 129.18                        | 131.11  | 23.96       | 24.44   |
| F - test        | S                                      | S       | S                                  | S       | S                                 | S       | S                             | S       | S           | S       |
| CD @ 5%         | 0.56                                   | 0.60    | 4.80                               | 5.29    | 0.09                              | 0.09    | 5.11                          | 5.55    | 1.80        | 1.56    |
| S.Ed. (±)       | 0.28                                   | 0.29    | 2.35                               | 2.59    | 0.04                              | 0.05    | 2.50                          | 2.72    | 0.40        | 0.75    |

**Table 3. Effect of different levels of zinc and iron on grain yield (q ha<sup>-1</sup>) and stover yield (q ha<sup>-1</sup>) of chickpea**

| Treatments      | Grain Yield (q ha <sup>-1</sup> ) |         | Stover Yield (q ha <sup>-1</sup> ) |         |
|-----------------|-----------------------------------|---------|------------------------------------|---------|
|                 | 2020-21                           | 2021-22 | 2020-21                            | 2021-22 |
| T <sub>1</sub>  | 7.20                              | 7.38    | 23.56                              | 24.15   |
| T <sub>2</sub>  | 8.88                              | 9.10    | 26.27                              | 26.93   |
| T <sub>3</sub>  | 9.09                              | 9.32    | 25.22                              | 25.85   |
| T <sub>4</sub>  | 9.65                              | 9.89    | 25.55                              | 26.19   |
| T <sub>5</sub>  | 10.27                             | 10.53   | 26.61                              | 27.28   |
| T <sub>6</sub>  | 10.04                             | 10.29   | 26.93                              | 27.60   |
| T <sub>7</sub>  | 11.50                             | 11.79   | 27.75                              | 28.44   |
| T <sub>8</sub>  | 11.42                             | 11.71   | 27.61                              | 28.30   |
| T <sub>9</sub>  | 12.33                             | 12.64   | 27.45                              | 28.14   |
| T <sub>10</sub> | 12.16                             | 12.46   | 28.48                              | 29.19   |
| T <sub>11</sub> | 12.45                             | 12.76   | 27.99                              | 28.69   |
| T <sub>12</sub> | 13.15                             | 13.48   | 28.76                              | 29.48   |
| T <sub>13</sub> | 13.08                             | 13.41   | 29.42                              | 30.16   |
| T <sub>14</sub> | 13.28                             | 13.61   | 28.92                              | 29.64   |
| T <sub>15</sub> | 13.05                             | 13.38   | 29.58                              | 30.32   |
| T <sub>16</sub> | 14.12                             | 14.47   | 29.74                              | 30.48   |
| F - test        | S                                 | S       | S                                  | S       |
| CD @ 5%         | 0.54                              | 0.71    | 0.97                               | 1.21    |
| S.Ed. (±)       | 0.26                              | 0.35    | 0.47                               | 0.59    |

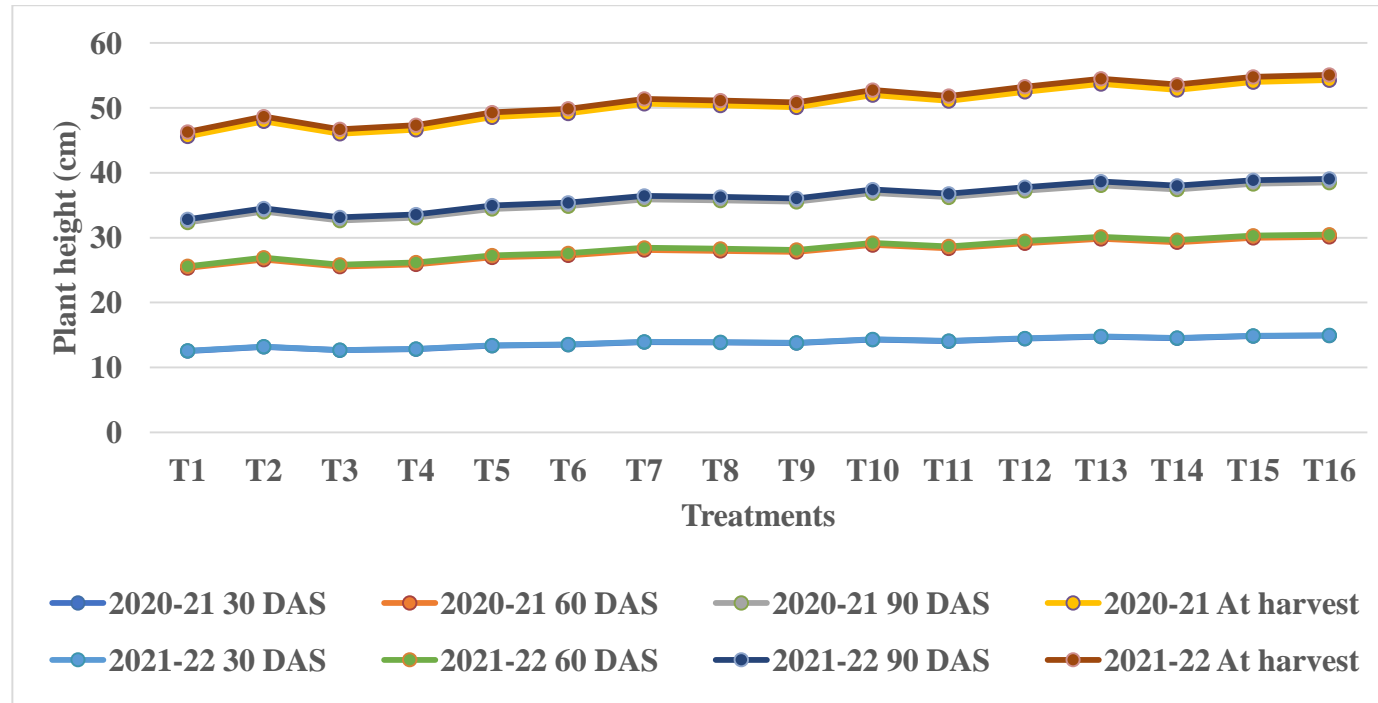


Fig. 1. Effect of different levels of zinc and iron on plant height (cm) at different days interval of chickpea

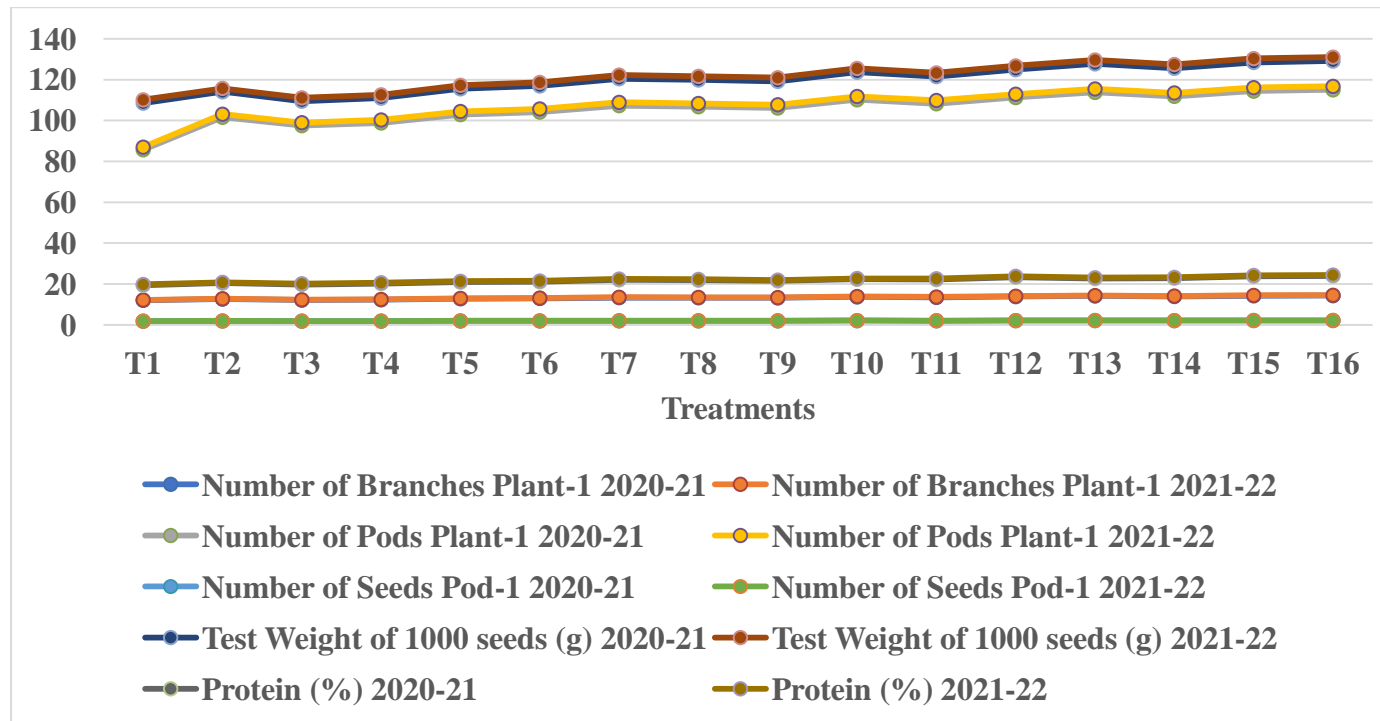


Fig. 2. Effect of different levels of zinc and iron on number of branches plant<sup>-1</sup>, number of pods plant<sup>-1</sup>, number of seeds pod<sup>-1</sup>, test weight of 1000 seeds (g) and protein (%) of chickpea

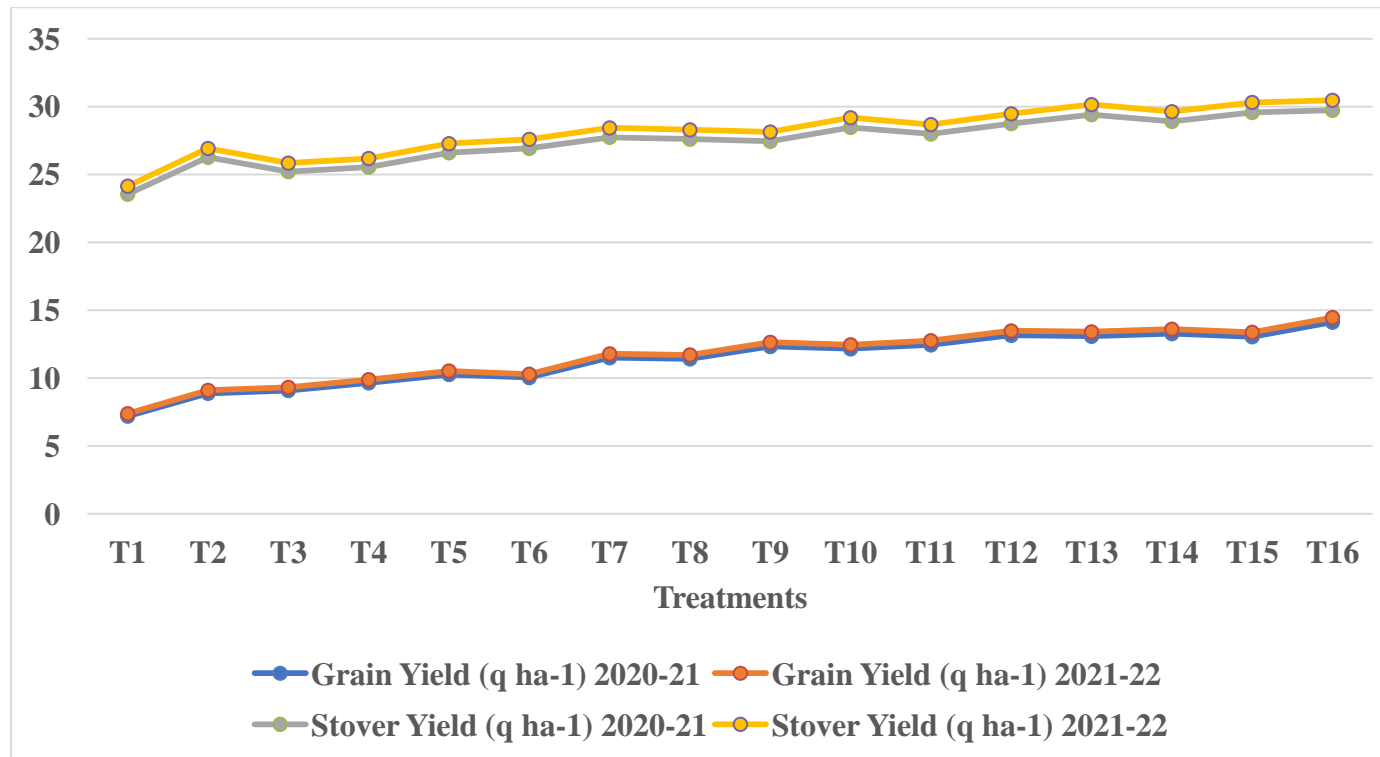


Fig. 3. Effect of different levels of zinc and iron on grain yield (q ha<sup>-1</sup>) and stover yield (q ha<sup>-1</sup>) of chickpea



The protein (%) of chickpea were found to be maximum 23.96% in 2020-21 and 24.44% in 2021-22 in treatment T<sub>16</sub> (RDF @ 100% + Zinc @ 20 kg ha<sup>-1</sup> + Iron @ 7.5 kg ha<sup>-1</sup>) followed by 23.76% in 2020-21 and 24.24% in 2021-22 in treatment T<sub>15</sub> (RDF @ 100% + Zinc @ 20 kg ha<sup>-1</sup> + Iron @ 5 kg ha<sup>-1</sup>) and minimum 19.43% in 2020-21 and 19.82% in 2021-22 in treatment T<sub>1</sub> [Absolute control (RDF @ 0% + Zinc @ 0 kg ha<sup>-1</sup> + Iron @ 0 kg ha<sup>-1</sup>)] respectively [14,16].

A critical perusal of data pertaining in the Table 3 and Fig. 3 the effect of different levels of Zn and Fe on plant of chickpea in both the years (2020-21 and 2021-22) was found to be significant at C.D @ 5%. The seed yield of chickpea was found to be maximum 14.12 q ha<sup>-1</sup> in 2020-21 and 14.47 q ha<sup>-1</sup> in 2021-22 in treatment T<sub>16</sub> (RDF @ 100% + Zinc @ 20 kg ha<sup>-1</sup> + Iron @ 7.5 kg ha<sup>-1</sup>) followed by 13.28 q ha<sup>-1</sup> in 2020-21 and 13.61 q ha<sup>-1</sup> in 2021-22 in treatment T<sub>14</sub> (RDF @ 100% + Zinc @ 20 kg ha<sup>-1</sup> + Iron @ 2.5 kg ha<sup>-1</sup>) and minimum 7.20 q ha<sup>-1</sup> in 2020-21 and 7.38 q ha<sup>-1</sup> in 2021-22 in treatment T<sub>1</sub> [Absolute control (RDF @ 0% + Zinc @ 0 kg ha<sup>-1</sup> + Iron @ 0 kg ha<sup>-1</sup>)] respectively. The stover yield of chickpea was found to be maximum 29.74 q ha<sup>-1</sup> in 2020-21 and 30.48 q ha<sup>-1</sup> in 2021-22 in treatment T<sub>16</sub> (RDF @ 100% + Zinc @ 20 kg ha<sup>-1</sup> + Iron @ 7.5 kg ha<sup>-1</sup>) followed by 29.58 q ha<sup>-1</sup> in 2020-21 and 30.32 q ha<sup>-1</sup> in 2021-22 in treatment T<sub>15</sub> (RDF @ 100% + Zinc @ 20 kg ha<sup>-1</sup> + Iron @ 5 kg ha<sup>-1</sup>) and minimum 23.56 q ha<sup>-1</sup> in 2020-21 and 24.15 q ha<sup>-1</sup> in 2021-22 in treatment T<sub>1</sub> [Absolute control (RDF @ 0% + Zinc @ 0 kg ha<sup>-1</sup> + Iron @ 0 kg ha<sup>-1</sup>)] respectively [17,18].

### 3. CONCLUSION

According to the results revealed the treatment T<sub>16</sub> (RDF @ 100% + Zinc @ 20 kg ha<sup>-1</sup> + Iron @ 7.5 kg ha<sup>-1</sup>) was seen to be best for all the plant parameters which is followed by treatment T<sub>15</sub> (RDF @ 100% + Zinc @ 20 kg ha<sup>-1</sup> + Iron @ 5 kg ha<sup>-1</sup>) and the lowest treatment was T<sub>1</sub> [Absolute control (RDF @ 0% + Zinc @ 0 kg ha<sup>-1</sup> + Iron @ 0 kg ha<sup>-1</sup>)]. Which proved that full dose of NPK, Fe and Zn are recommendable to the farmers for increasing seed yield.

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### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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