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# Effect of multiplex yield enhancers on ridge gourd growth and yield parameter along with pest and disease incidence

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**Abstract**
Multiplex yield enhancers were evaluated in ridge gourd crops at the College of Horticulture in Bengaluru to study their impact on growth parameters, yield parameters, pest and disease incidence. The combination of bio-organic manure, secondary and micronutrients along with biostimulants and recommended dose of fertilizers showed an initial increase in the height of the plant. Treatment $T_{13}$ showed the highest number of branches (1.44 and 3.11) at 30 and 60 days after planting, while treatment $T_4$ showed the highest number of leaves. Treatment $T_{16}$, which included Annapurna, Samrddhi, Organic magik, Zinc high, and Navjeevan G recorded the highest number of fruits (29) and yield per vine (1768.33 g). Treatment $T_{14}$ demonstrated a lower percent disease index of powdery mildew at 8.52, while $T_5$ (7.95) recorded a lower percent disease index of downy mildew. Similarly, the treatment that included Bio Jodi reduced the infestation of pests and diseases. The various multiplex yield enhancers worked variably at different stages of the crop as required. The combination of organic and chemical fertilizers works synergistically to improve the yield of the ridge gourd crop.

**Keywords:** Multiplex yield enhancers, ridge gourd growth, yield parameter along, pest, disease incidence

## Introduction
Ridge gourd, also known as *Luffa acutangulla*, is a popular tropical and subtropical vegetable that belongs to the *Luffa* genus of the Cucurbitaceae family (Hassain MS., 2013) [8]. It is widely used as a vegetable in India and Southeast Asia and is considered one of the most preferred summer vegetables after potatoes. Ridge gourd is highly nutritious as it is rich in dietary fiber and contains all the vital elements required for good health. It is a great source of vitamins and minerals such as zinc, iron, riboflavin, magnesium, thiamine, and other minerals. Additionally, it is low in saturated fat, cholesterol, and calories, which makes it an ideal food for weight loss.
Ridge gourd is a vegetable that can help relieve constipation due to its high cellulose and water content. It provides numerous health benefits such as blood purification, laxative properties, anti-inflammatory and antibiotic properties, and immune system fortification. It can also help cure jaundice, and diabetes, improve skin health, and promote good digestive health. However, since ridge gourd is part of the Cucurbitaceous family of vegetables, it tends to have creeping, climbing, and trailing habits, which makes it vulnerable to plant diseases such as Phytophthora blight, collar rot, bacterial wilt, gummosis, downy mildew, and anthracnose (Bellamkonda *et al*., 2020) [6]. Surface irrigation can exacerbate this problem, but applying bio-enriched organic manure at the base can help to prevent these diseases (Ali *et al*., 2009) [2].
To achieve maximum production, ridge gourd, like other vegetable crops, requires essential nutrients that can be supplied through chemical fertilization. However, the continuous use of high levels of chemical fertilizers reduces the nutrient uptake efficiency of plants. This results in either stagnation or a decrease in yield and causes environmental pollution. Therefore, an integrated supply of nutrients through organic, inorganic, and biofertilizers is necessary for sustainable productivity and to maintain better soil health. The application of eco-friendly bio-fertilizers and low-cost input with organic and inorganic fertilizers play significant roles in plant

nutrition (Singh and Kaloo, 2000) [18]. The utilization of diverse agricultural inputs, including organic and inorganic fertilizers, amino acids, biostimulants, bio fertilizers, and biopesticides, has been shown to significantly improve crop productivity, soil health, and ecological safety (Kameswari *et al*., 2010) [10]. This approach enables the effective utilization of local resources while also addressing micronutrient deficiencies. A recent study was carried out to assess the effects of these yield enhancers on growth and yield parameters, as well as the incidence of pests and diseases. The primary objective of the experiment was to determine the most efficacious combination of inputs to support robust crop growth and maximize overall yield.

## Materials and method

The experiment was carried out at the College of Horticulture, UHS Campus, GKVK Post, Bengaluru. Sixteen treatments (Table 1) were randomly assigned to the plots and replicated three times.

For the trial, a commercially grown and much-appreciated hybrid of ridge gourd, Naga F1, from East West Company was used. The main field was properly plowed, leveled and farmyard manure was applied at a rate of 20 tons per hectare during the last plowing. Two seeds were sown per pit with a spacing of 120 cm x 90 cm, and later, one seedling was retained. Annapurna was mixed with the FYM in the respective beds and the recommended dose of basal N:P: K at 50:50:50 kg per hectare was applied for the entire field.

Fifty percent of N was applied at the time of transplanting and the remaining 50 percent of N was applied at the time of earthing up. Two rows of marigolds were planted to prevent nematode infestation in between the ridge gourd lines, and maize was grown around the borders of the field. Sticky traps were used to manage insects, and appropriate plant protection measures were taken to control different pests and diseases throughout the cropping period.

Twenty-five plants were planted for each treatment. The details of the treatments are given below.

**Table 1:** Treatment details

| Sl. No | Treatment | Method of application |
|---|---|---|
| $T_1$ | RDF (N :P: K) + (FYM) | Basal dose |
| $T_2$ | RDF + Annapurna @ 150 kg/ac | Basal dose |
| $T_3$ | RDF + Annapurna @ 240 kg/ac | Basal dose |
| $T_4$ | RDF + Annapurna @ 450 kg/ac | Basal dose |
| $T_5$ | RDF + Organic magic @ 10 kg/ac | Basal dose |
| $T_6$ | RDF + Samruddhi @ 50 kg/ac | 50% each as basal + Earthing up |
| $T_7$ | RDF + Zinc high @ 10 kg/ac | 50% each as Basal + Earthing up |
| $T_8$ | RDF + Navjeevan G @ 10 kg/ac | 50% each as Basal + Earthing up |
| $T_9$ | RDF + Jivras @ 3 ml/L | After planting and before flowering during vegetative phase |
| $T_{10}$ | RDF + Annapurna (240 kg/ac) + Samruddhi (50 kg/ac) + Zinc high (10 kg/ac) + Navjeevan G (10 kg/ac) | Basal dose + Earthing up |
| $T_{11}$ | RDF + Mahapal @ 3 ml/L + Bio jodi @ 5 g/L | 3 Foliar sprays during the vegetative phase, flowering to fruit setting and fruit development stage. (Except Kranti -2 sprays) |
| $T_{12}$ | RDF + Sambrama @ 5 g/15l + Bio jodi @ 5 g/L | |
| $T_{13}$ | RDF + Samras @ 3 ml/L + Bio jodi @ 5 g/L | |
| $T_{14}$ | RDF + Kranti @ 2 ml/L + Bio jodi @ 5 g/L | |
| $T_{15}$ | RDF + Foliar spray (Mahapal + samras + sambrama + Bio jodi) | |
| $T_{16}$ | RDF + (Annapurna (120 kg/ac) + Samruddhi (25 kg/ac) + organic magic (5 kg/ac) + Zinc high (5 kg/ac) + Navajeevan G (5 kg/ac) | Basal dose + Earthing up |

**Note:** RDF-Recommended Dose of Fertilizer, DAP- Days after planting, FYM – Farmyard manure, NS- non-significant, Annapurna- Decomposed organic matter fortified with vermicompost, Neem Cake, Castor Cake, Coir pith & enriched with millions of beneficial Microorganism, Organic magic: Phosphate solubilizing fungal Bio-Fertilizer along with PGPR bacterial consortium, Samruddhi: Contains secondary nutrients such as Calcium, Magnesium and Sulphur, Zinc high : Contains high percentage of Zinc, Magnesium apart from other secondary and micronutrients like calcium, manganese, molybdenum, boron and sulphur in easily available form, Navajeevan G: Contains Sea-weed, humic acid and a mixture of amino acid and triacontanol, Jivras: Contains Humic acid 12.0% w/w, Mahapal: A combination product of bio-organics and traces of micronutrients in balanced quantity in chelated form, Sambrama: This contains all essential plant nutrients like major nutrients, secondary and micronutrients in chelated form, Biojodi: *Bacillus spp. & Pseudomonas spp.,* Samras: Contains a mixture of 18 natural amino acids, extracted from plant source, Kranti: This contains all essential plant nutrients like major nutrients, secondary and micronutrients in chelated form

Observations recorded: all the observations were recorded on five plants at 30, 60 and 90 DAP

### Growth parameters

Plant height (cm): Plant height was recorded from the ground level to the tip of the main shoot.

**Number of leaves per plant:** The total number of leaves from each plant was counted.

**Number of laterals per plant:** The total number of branches arising from the main stem of each selected plant

### Yield parameters

Total number of fruits per plant: The number of fruits harvested from different harvests was added to obtain the total number of fruits per plant.

Fruit yielded per plant (kg): The weight of fruits harvested from each picking was recorded from five labeled plants of each plot and the total yield per plant was worked out by adding the yield of each harvest.

Fruit yield: The total yield per hectare was estimated based on the fruit yield per plant from each harvest to the number of plants per hectare.

$$\text{Fruit yield} = \frac{\text{Fruit yield per plot}}{\text{Net plot area (m}^2\text{)}} \text{X } 10{,}000$$

**Disease incidence**

**Fungal disease**

- The major disease occurring on the crops were recorded at every 15 days interval using the 0-5 scale for various crops and various diseases.
- Percent disease index (PDI) was calculated using the formula.

$$(\text{PDI}) = \frac{\text{The sum of the individual disease ratings}}{\text{A number of fruits/ leaves observe}} \text{X} \frac{100}{\text{Maximum disease grade.}}$$

Bacterial and viral diseases

- The percentage incidence was calculated using the formula.

$$\text{Percent incidence} = \frac{\text{Number of plants infected}}{\text{Total number of plants}} \text{X } 100$$

**Insect incidence**

- The incidence of insects on all the crops was recorded at 15-day intervals.

**Analysis and result**

All the parameters were analyzed using the statistical tool SPSS. ANOVA was done for all the experiments using CD at 5% using LSD.

## Results and Discussion

### Growth parameters

### 1. Plant height (cm)

The height of plants on 30, 60, and 90 DAP were recorded and analyzed for statistical significance. The results are presented in Table 2, which shows a significant difference in plant height across all intervals. Treatment 10 had the highest plant height at 30 (115.67 cm) and 60 (175 cm) days after planting. This treatment included a combination of both chemical and organic nutrients that made the nutrients readily available for absorption and translocation by plants, leading to a higher rate of photosynthetic activity and thus a taller plant height. Among all the treatments, $T_8$ - which involved the application of RDF + Navajeevan G @ 10 kg/ac - recorded the longest vine length of 287.67cm at 90 DAP. This treatment includes biostimulant amino acids and RDF, which contains an essential nutrient N that plays a crucial role in metabolism. N is required for the production of amino acids, proteins, nucleic acids, enzymes, co-enzymes, and alkaloids, as noted by Anjanappa *et al* in 2012 [3]. This treatment might have fulfilled the crop's requirements, increasing the vine's length. At all intervals, plant height increased in every treatment except $T_1$ which produced the shortest height with the application of RDF only.

**Table 2:** Impact of multiplex yield enhancers on plant height of Ridge gourd

| Sl. No | Treatment | Plant height (cm) | | |
|---|---|---|---|---|
| | | 30 DAP | 60 DAP | 90 DAP |
| $T_1$ | RDF (N :P: K) + (FYM) | 66.33 | 125.67 | 179.11 |
| $T_2$ | RDF + Annapurna @ 150 kg/ac | 76.89 | 136.22 | 223.00 |
| $T_3$ | RDF + Annapurna @ 240 kg/ac | 93.89 | 153.22 | 212.11 |
| $T_4$ | RDF + Annapurna @ 450 kg/ac | 94.56 | 153.89 | 259.44 |
| $T_5$ | RDF + Organic magic @ 10 kg/ac | 90.67 | 150.00 | 193.56 |
| $T_6$ | RDF + Samruddhi @ 50 kg/ac | 97.22 | 156.56 | 232.00 |
| $T_7$ | RDF + Zinc high @ 10 kg/ac | 105.00 | 164.33 | 243.89 |
| $T_8$ | RDF + Navjeevan G @ 10 kg/ac | 113.78 | 173.11 | 287.67 |
| $T_9$ | RDF + Jivras @ 3 ml/L | 114.56 | 173.89 | 212.44 |
| $T_{10}$ | RDF + Annapurna (240 kg/ac) + Samruddhi (50 kg/ac) + Zinc high (10 kg/ac) + Navjeevan G (10 kg/ac) | 115.67 | 175.00 | 220.00 |
| $T_{11}$ | RDF + Mahapal @ 3 ml/L + Bio jodi @ 5 g/L | 99.11 | 158.44 | 251.56 |
| $T_{12}$ | RDF + Sambrama @ 5 g/15l + Bio jodi @ 5 g/L | 100.56 | 159.89 | 242.22 |
| $T_{13}$ | RDF + Samras @ 3 ml/L + Bio jodi @ 5 g/L | 101.33 | 160.67 | 233.44 |
| $T_{14}$ | RDF + Kranti @ 2 ml/L + Bio jodi @ 5 g/L | 83.89 | 143.22 | 194.56 |
| $T_{15}$ | RDF + Foliar spray (Mahapal + samras + sambrama + Bio jodi) | 90.22 | 149.56 | 233.89 |
| $T_{16}$ | RDF + (Annapurna (120 kg/ac) + Samruddhi (25 kg/ac) + organic magic (5 kg/ac) + Zinc high (5 kg/ac) + Navajeevan G (5 kg/ac) | 85.33 | 144.67 | 262.11 |
| S.Em + | | 14.26 | 14.26 | 19.27 |
| C.D @ 5% | | NS | NS | 55.94 |
| C.V @ 5% | | 25.85 | 15.95 | 14.51 |

**Note:** RDF-Recommended Dose of Fertilizer: DAP- Days after planting: FYM – Farmyard manure: NS- non-significant

### 2. Number of Lateral per plant:

Table 3 records the total number of branches at 30, 60, and 90DAP. The highest number of Laterals per plant was observed in Treatment $T_{13}$ with 1.44 and 3.11 branches at 30 and 60 days, respectively. Treatment $T_{15}$ recorded the highest of 4.89 branches per plant at 90 DAP. This acceleration in growth could be attributed to the recommended dosage of fertilizers containing amino acids, which activate cell division and cell elongation in axillary buds. This may have had a promoting effect on vein length and the length of the internode. A study conducted by Baghel *et al*. (2017) [4] found that the early application of RDF with biopesticides and foliar nutrients increased the number of laterals and improved the root system, plant height, and the number of branches and leaves. Among all the treatments, $T_1$ had the lowest number of branches per plant. The use of organic fertilizers, poultry manure, and inorganic fertilizers promotes plant growth compared to controlled types. Organic manure improves the physical and biological properties of soil, providing balanced nutrients to the plant, which in turn promotes vegetative growth (Priyadharshini, V., 2022) [14].

**Table 3:** Impact of multiplex yield enhancers on number of laterals in Ridge gourd

| Sl. No | Treatment | Number of branches per plant | | |
|---|---|---|---|---|
| | | 30 DAP | 60 DAP | 90 DAP |
| $T_1$ | RDF (N :P: K) + (FYM) | 0.56 | 2.22 | 3.78 |
| $T_2$ | RDF + Annapurna @ 150 kg/ac | 0.78 | 2.44 | 4.00 |
| $T_3$ | RDF + Annapurna @ 240 kg/ac | 1.33 | 3.00 | 4.33 |
| $T_4$ | RDF + Annapurna @ 450 kg/ac | 1.33 | 3.00 | 4.56 |
| $T_5$ | RDF + Organic magic @ 10 kg/ac | 1.00 | 2.67 | 4.00 |
| $T_6$ | RDF + Samruddhi @ 50 kg/ac | 1.11 | 2.78 | 4.11 |
| $T_7$ | RDF + Zinc high @ 10 kg/ac | 0.78 | 2.44 | 4.11 |
| $T_8$ | RDF + Navjeevan G @ 10 kg/ac | 1.00 | 2.67 | 4.44 |
| $T_9$ | RDF + Jivras @ 3 ml/L | 1.22 | 2.89 | 3.89 |
| $T_{10}$ | RDF + Annapurna (240 kg/ac) + Samruddhi (50 kg/ac) + Zinc high (10 kg/ac) + Navjeevan G (10 kg/ac) | 1.33 | 3.00 | 4.44 |
| $T_{11}$ | RDF + Mahapal @ 3 ml/L + Bio jodi @ 5 g/L | 1.00 | 2.67 | 3.78 |
| $T_{12}$ | RDF + Sambrama @ 5 g/15l + Bio jodi @ 5 g/L | 1.22 | 2.89 | 4.11 |
| $T_{13}$ | RDF + Samras @ 3 ml/L + Bio jodi @ 5 g/L | 1.44 | 3.11 | 4.56 |
| $T_{14}$ | RDF + Kranti @ 2 ml/L + Bio jodi @ 5 g/L | 1.00 | 2.67 | 4.00 |
| $T_{15}$ | RDF + Foliar spray (Mahapal + samras + sambrama + Bio jodi) | 1.00 | 3.00 | 4.89 |
| $T_{16}$ | RDF + (Annapurna (120 kg/ac) + Samruddhi (25 kg/ac) + organic magic (5 kg/ac) + Zinc high (5 kg/ac) + Navajeevan G (5 kg/ac) | 1.00 | 2.67 | 4.00 |
| S.Em + | | 0.25 | 0.25 | 0.31 |
| C.D @ 5% | | NS | NS | NS |
| C.V @ 5% | | 40.15 | 15.75 | 12.65 |

**Note:** RDF-Recommended Dose of Fertilizer; DAP- Days after planting; FYM – Farmyard manure; NS- non-significant

### 3. Number of leaves

Several leaves appeared at different intervals, and they varied significantly between the treatments. $T_4$ (RDF + Annapurna @ 450 kg/ac) had the highest number of leaves at 30, 60, and 90 DAP with 13.11, 36.78, and 63.44, respectively. The minimum number of leaves was observed in $T_1$ at all the intervals. The application of different multiplex enhancers did not significantly influence the number of leaves at 30 DAP but it had a significant impact after 60 DAP as presented in Table 4. The treatment contains Annapurna, which is bio-enriched organic manure consisting of de-oiled cakes, biofertilizers, and biopesticides. This organic treatment enhances the accessibility of plant nutrients. When this organic nutrient is combined with RDF, it significantly increases the number of leaves, as concluded by Barik *et al*. (2018) [5]. These findings are consistent with those of Singh *et al*. (2018) [17], who conducted similar research in the field of cucumber.

**Table 4:** Impact of multiplex yield enhancers on number of leaves of Ridge gourd

| Sl. No | Treatment | Number of laves per plant | | |
|---|---|---|---|---|
| | | 30 DAP | 60 DAP | 90 DAP |
| $T_1$ | RDF (N :P: K) + (FYM) | 9.22 | 32.89 | 46.56 |
| $T_2$ | RDF + Annapurna @ 150 kg/ac | 9.56 | 33.22 | 50.56 |
| $T_3$ | RDF + Annapurna @ 240 kg/ac | 11.33 | 35.00 | 50.67 |
| $T_4$ | RDF + Annapurna @ 450 kg/ac | 13.11 | 36.78 | 63.44 |
| $T_5$ | RDF + Organic magic @ 10 kg/ac | 9.89 | 33.56 | 47.78 |
| $T_6$ | RDF + Samruddhi @ 50 kg/ac | 11.22 | 34.89 | 53.22 |
| $T_7$ | RDF + Zinc high @ 10 kg/ac | 12.56 | 36.22 | 54.56 |
| $T_8$ | RDF + Navjeevan G @ 10 kg/ac | 11.44 | 35.11 | 55.56 |
| $T_9$ | RDF + Jivras @ 3 ml/L | 12.11 | 35.78 | 47.97 |
| $T_{10}$ | RDF + Annapurna (240 kg/ac) + Samruddhi (50 kg/ac) + Zinc high (10 kg/ac) + Navjeevan G (10 kg/ac) | 12.22 | 35.89 | 58.56 |
| $T_{11}$ | RDF + Mahapal @ 3 ml/L + Bio jodi @ 5 g/L | 9.56 | 33.22 | 55.33 |
| $T_{12}$ | RDF + Sambrama @ 5 g/15l + Bio jodi @ 5 g/L | 12.33 | 36.00 | 50.78 |
| $T_{13}$ | RDF + Samras @ 3 ml/L + Bio jodi @ 5 g/L | 10.89 | 34.56 | 57.44 |
| $T_{14}$ | RDF + Kranti @ 2 ml/L + Bio jodi @ 5 g/L | 12.11 | 35.78 | 56.56 |
| $T_{15}$ | RDF + Foliar spray (Mahapal + samras + sambrama + Bio jodi) | 10.67 | 34.33 | 60.89 |
| $T_{16}$ | RDF + (Annapurna (120 kg/ac) + Samruddhi (25 kg/ac) + organic magic (5 kg/ac) + Zinc high (5 kg/ac) + Navajeevan G (5 kg/ac) | 9.56 | 33.22 | 60.56 |
| S.Em + | | 1.01 | 1.01 | 2.69 |
| C.D @ 5% | | NS | NS | 7.81 |
| C.V @ 5% | | 15.69 | 5.01 | 13.97 |

**Note:** RDF-Recommended Dose of Fertilizer: DAP- Days after planting: FYM – Farmyard manure: NS- non-significant

**Yield attributes**

**1. Number of fruits**

The table named Table 5 shows the total number of fruits per plant that were harvested during different pickings. The length and weight of the fruits varied depending on the different treatments used during the picking. Treatment $T_{10}$, which consisted of RDF, Annapurna (240 kg), Samruddhi (50 kg), Zinc High (10 kg), and Navajeevan G (10 kg), had the highest number of fruits per vine, with 30 fruits. Treatment $T_{16}$ followed closely behind with 29 fruits per vine. On the other hand, treatments $T_9$ and $T_1$ had the lowest number of fruits per vine, with only 16 fruits. This outcome may have resulted from the combined effect of organic fertilizers and micro/macronutrients plus amino acids, which contributed to the growth of fruits (Nirmal, 1999) [12]. Prashanti *et al* (2021) [13] also found that using 50% recommended dose of fertilizer (RDF) in combination with organic manure was beneficial for increasing the yield of ridge gourd in the Kharif season. This treatment also led to the highest number of leaves, and if the leaf area and vine length increase, it is possible to have more flowers and fruits.

**Table 5:** Impact of multiplex yield enhancers on yield of ridge gourd

| | Treatment | Fruit yield/vine | No. of fruits/vine | Yield/ha (tons) |
|---|---|---|---|---|
| $T_1$ | RDF (N :P: K) + (FYM) | 559.33 | 16 | 5.18 |
| $T_2$ | RDF + Annapurna @ 150 kg/ac | 660.00 | 23 | 6.11 |
| $T_3$ | RDF + Annapurna @ 240 kg/ac | 929.33 | 25 | 8.60 |
| $T_4$ | RDF + Annapurna @ 450 kg/ac | 1297.67 | 25 | 12.02 |
| $T_5$ | RDF + Organic magic @ 10 kg/ac | 864.00 | 22 | 8.00 |
| $T_6$ | RDF + Samruddhi @ 50 kg/ac | 947.00 | 28 | 8.77 |
| $T_7$ | RDF + Zinc high @ 10 kg/ac | 1092.67 | 27 | 10.12 |
| $T_8$ | RDF + Navjeevan G @ 10 kg/ac | 1331.33 | 28 | 12.33 |
| $T_9$ | RDF + Jivras @ 3 ml/L | 922.67 | 16 | 8.54 |
| $T_{10}$ | RDF + Annapurna (240 kg/ac) + Samruddhi (50 kg/ac) + Zinc high (10 kg/ac) + Navjeevan G (10 kg/ac) | 1102.33 | 30 | 10.21 |
| $T_{11}$ | RDF + Mahapal @ 3 ml/L + Bio jodi @ 5 g/L | 1083.33 | 28 | 10.03 |
| $T_{12}$ | RDF + Sambrama @ 5 g/15l + Bio jodi @ 5 g/L | 1013.00 | 22 | 9.38 |
| $T_{13}$ | RDF + Samras @ 3 ml/L + Bio jodi @ 5 g/L | 1250.67 | 23 | 11.58 |
| $T_{14}$ | RDF + Kranti @ 2 ml/L + Bio jodi @ 5 g/L | 628.00 | 20 | 5.81 |
| $T_{15}$ | RDF + Foliar spray (Mahapal + samras + sambrama + Bio jodi) | 1323.00 | 27 | 12.25 |
| $T_{16}$ | RDF + (Annapurna (120 kg/ac) + Samruddhi (25 kg/ac) + organic magic (5 kg/ac) + Zinc high (5 kg/ac) + Navajeevan G (5 kg/ac) | 1768.33 | 29 | 16.37 |
| S.Em + | | 140.39 | 2.17 | 1.33 |
| C.D @ 5% | | 407.43 | 6.31 | 3.77 |
| C.V @ 5% | | 23.20 | 12.61 | 23.19 |

**Note:** RDF-Recommended Dose of Fertilizer: DAP- Days after planting; FYM – Farmyard manure; NS- non-significant

**2. Fruit yield (t/ha)**

The table below presents data on the fruit yield of ridge gourd, which was influenced by yield enhancers. In total, nine pickings were made from the experimental plot, and immature fruits were harvested. Treatment $T_{16}$, which involved the use of RDF along with Annapurna (120 kg/ac), Samruddhi (25 kg/ac), Organic Magik (5 kg/ac), Zinc High (5 kg/ac), and Navajeevan G (5 kg/ac), recorded significantly higher fruit yield per plant and per hectare, at 1.76 kg and 16.37 t/ha, respectively. On the other hand, treatment $T_1$, which involved the application of RDF only, had the lowest fruit yield per plant and per hectare, at 0.55 kg and 5.18 t/ha, respectively. It is worth noting that the application of different yield enhancers significantly increased the fruit yield in all treatments.

According to Renuka B (2001) [16], the positive yield attributes observed in crops could be due to a balanced supplement of nutrients from organic manures along with microbial action. Additionally, the improved dry matter accumulation in plants could be attributed to the enhanced release of micronutrients from added sources of N, P, and K, as well as the release of nutrients during mineralization (Choudhary *et al*., 2020: Rathod *et al*., 2018) [7, 15]. The physicochemical properties of soil are also improved due to the application of organic carbon in the form of vermicompost, which helps in enhancing the soil's nutrient status. Furthermore, the quality of fruit can also be improved by using these methods, as observed by Barik *et al.* (2018) [5].

**3. Disease and pest incidence:**

Gourd diseases such as powdery mildew, downy mildew, and yellow mosaic virus were monitored regularly, and the incidence of various diseases is presented in Table 6. Treatment $T_{14}$ (RDF + Kranti + Bio Jodi @ 5 g/1) showed a lower percent disease index of powdery mildew at 8.52. The treatment $T_5$ (7.95) had a lower PDI of downy mildew, followed by $T_{12}$ (8.99). Comparatively, $T_1$ had a higher incidence of PDI in both powdery mildew (20.63) and downy mildew (40.28). The percentage of plants infected by ridge gourd yellow mosaic virus was lowest in $T_{16}$ (5.33%) as indicated in Table 6. Some of the major pest infestations seen during the cropping period were red pumpkin beetle, melon fruit fly, and leaf minor which are presented in Table 6. The Melon fruit fly caused less fruit damage in $T_{14}$ (RDF + Kranti @ 2 m1/1 + Bio Jodi @ 5 g/1) with 14.86 % damage on fruit. The per cent leaf minor damage levels on leaves were found to be minimal in $T_4$ with only 22.79 % of leaf damage, followed by $T_{16}$ and $T_{15}$ with 25.06 % and 25.82 % and higher with 45.55% in $T_1$. The red pumpkin beetle was found in lower numbers with 1.33 each in $T_{15}$, $T_{10}$, $T_4$ and $T_{16}$.

**Table 6:** Impact of multiplex yield enhancers on disease incidence in ridge gourd

| Treatment | | Percent infection of mosaic virus (RgYMV) | PDI | | Red pumpkin beetle | Percent melon fruit fly damage on fruits | Percent leaf miner damage |
|---|---|---|---|---|---|---|---|
| | | | PM | DM | | | |
| $T_1$ | RDF (N :P: K) + (FYM) | 14.67 (22.52) | 20.63 (27.01) | 40.28 (39.40) | 2.67 | 18.26 (23.30) | 45.55 (42.45) |
| $T_2$ | RDF + Annapurna @ 150 kg/ac | 12.00 (20.27) | 19.88 (26.48) | 23.68 (29.12) | 2.00 | 17.54 (24.76) | 34.69 (36.08) |
| $T_3$ | RDF + Annapurna @ 240 kg/ac | 10.67 (19.07) | 14.08 (22.04) | 22.32 (28.19) | 2.00 | 16.20 (23.73) | 38.94 (38.61) |
| $T_4$ | RDF + Annapurna @ 450 kg/ac | 6.67 (14.97) | 11.96 (20.23) | 11.94 (20.21) | 1.33 | 15.80 (23.46) | 22.79 (28.51) |
| $T_5$ | RDF + Organic magic @ 10 kg/ac | 8.00 (16.43) | 8.97 (17.43) | 7.95 (16.38) | 1.67 | 15.85 (23.46) | 37.87 (37.98) |
| $T_6$ | RDF + Samruddhi @ 50 kg/ac | 6.67 (14.97) | 13.72 (21.74) | 12.90 (21.05) | 1.67 | 17.12 (24.44) | 36.05 (36.90) |
| $T_7$ | RDF + Zinc high @ 10 kg/ac | 8.00 (16.43) | 12.25 (20.49) | 13.32 (21.41) | 2.00 | 17.02 (24.37) | 40.57 (39.56) |
| $T_8$ | RDF + Navjeevan G @ 10 kg/ac | 12.00 (20.27) | 13.38 (21.46) | 9.66 (18.11) | 2.00 | 16.45 (23.93) | 37.73 (37.90) |
| $T_9$ | RDF + Jivras @ 3 ml/L | 9.33 (17.79) | 16.10 (23.66) | 11.02 (19.39) | 2.00 | 16.64 (24.07) | 31.93 (34.41) |
| $T_{10}$ | RDF + Annapurna (240 kg/ac) + Samruddhi (50 kg/ac) + Zinc high (10 kg/ac) + Navjeevan G (10 kg/ac) | 8.00 (16.43) | 14.79 (22.62) | 11.43 (19.76) | 1.33 | 16.35 (23.85) | 29.36 (32.81) |
| $T_{11}$ | RDF + Mahapal @ 3 ml/L + Bio jodi @ 5 g/L | 8.00 (16.43) | 14.56 (22.43) | 14.19 (22.13) | 1.67 | 16.62 (24.06) | 36.86 (37.38) |
| $T_{12}$ | RDF + Sambrama @ 5 g/15l + Bio jodi @ 5 g/L | 10.67 (19.07) | 8.97 (17.43) | 8.99 (13.72) | 2.33 | 16.48 (23.96) | 31.46 (34.12) |
| $T_{13}$ | RDF + Samras @ 3 ml/L + Bio jodi @ 5 g/L | 10.67 (19.07) | 15.53 (23.21) | 13.72 (7.96) | 2.33 | 16.04 (23.61) | 30.09 (33.27) |
| $T_{14}$ | RDF + Kranti @ 2 ml/L + Bio jodi @ 5 g/L | 10.67 (19.07) | 8.52 (16.97) | 7.96 (16.39) | 2.00 | 14.86 (22.67) | 38.07 (38.10) |
| $T_{15}$ | RDF + Foliar spray (Mahapal + samras + sambrama + Bio jodi) | 8.00 (16.43) | 13.80 (21.81) | 9.03 (17.49) | 1.33 | 15.74 (23.37) | 25.82 (30.54) |
| $T_{16}$ | RDF + (Annapurna (120 kg/ac) + Samruddhi (25 kg/ac) + organic magic (5 kg/ac) + Zinc high (5 kg/ac) + Navajeevan G (5 kg/ac) | 5.33 (13.35) | 12.60 (20.79) | 7.97 (16.40) | 1.33 | 16.73 (24.14) | 25.06 (30.04) |
| S.Em + | | 2.49 | 2.79 | 2.50 | 2.69 | 2.69 | 5.10 |
| C.D @ 5% | | NS | NS | 7.25 | NS | NS | NS |
| C.V @ 5% | | 46.18 | 35.24 | 30.57 | 45.86 | 28.36 | 26.05 |

**Note:** RDF-Recommended Dose of Fertilizer; DAP- Days after planting; FYM – Farmyard manure: NS- non-significant

The use of Bio-Jodi treatment in conjunction with nutrients is an efficient method for managing pests and diseases in crops. This is because the presence of *Bacillus* and *Pseudomonas* species in Bio-Jodi treatment helps to inhibit the growth of harmful pathogens by competing with them for food and producing secondary metabolites. Additionally, these microorganisms act as promoters of plant growth and have been found to have considerable effects on plant growth, root development, soil-borne disease control, and inducing plant systemic resistance. (Adesemoye *et al*., 2008; Huang *et al*., 2011) [1, 9]. When these biopesticides are given with nutrients, the plant is free from pests and disease. When biopesticides are used in conjunction with nutrients, plants become free from pests and diseases, and they grow better and produce higher yields. When a plant is provided with all the essential nutrients, it becomes more capable of induced resistance, as balanced nutrition acts as the first line of defense (Tripathi *et al.*, 2022) [21]. The application of amino acids, biofertilizers, and biopesticides together can boost the plant's resistance to pests. Additionally, including seaweed in the treatment can reduce the pest population (Sugandhika *et al.*, 2021) [19].

## Conclusion

Observations were made on the Naga F1 ridge gourd variety, which showed significant differences in growth, yield, pest and disease incidence between treatment. Treatments $T_4$, $T_8$, $T_{10}$, and $T_{15}$ demonstrated better growth and yield, whereas $T_5$, $T_{11}$, $T_{14}$, $T_{15}$, and $T_{16}$ showed lower pest infestations. Meanwhile, $T_4$, $T_5$, $T_6$, $T_{12}$ and $T_{14}$ recorded lower disease incidences. The conclusion drawn from these observations is that the use of various multiplex yield enhancers in conjunction with Bio jodi improved soil health and nutrient availability, thereby enhancing the growth and yield attributes, while also reducing pest and disease incidence.

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