Effect of Soil Mulching and Cobalt on Growth and Yield of (Phaseolus Vulgaris L.) Under Protected Conditions

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Abstract

The study was conducted during the winter season 2021 at the Agricultural Research Station of the College of Agriculture, University of Basra. In order to study the effect of soil Mulching and the addition of cobalt on the growth and green yield of green bean plants grown under greenhouses conditions, the experiment included 12 factorial treatments, which consist of the four types of plastic coverings (black, white, transparent and without Mulching) and three concentrations of cobalt as a cobalt sulfate (zero, 5 and 10) ml g L⁻¹, as the Mulching with white plastic achieved the best results in most of study parameters. The addition of cobalt at concentrations 5 and 10 ml g L⁻¹ recorded the best values in plant height, number of leaves, leaf area and number of root nodes, and white and black caps also outperformed in pod weight, yield of plant green pods, total yield of green pods and pod length. The white cover achieved the best value in the percentage of protein of seeds, while the transparent cover was recorded best value in the percentage of dry matter in the seeds. Foliar cobalt application of concentrations 5 and 10 mlg L⁻¹ recorded best value in pod weight and per the yield of pods. Plant yield, pod diameter and the percent of dry matter in the seeds, and the concentration of 5 mlg L⁻¹ achieved the highest value in the number of pods and protein content in the seeds.

Keywords: Cobalt, Green beans, Soil Mulching, Vegetable growth.

1. Introduction

Green beans (Phaseolus vulgaris L.) to fabaceae, one of the world's most widely spread vegetable crops with a high nutritional and medical value, it is green thrones per 100 g of which contains 90.14. G water, 2.31 g protein, 0.5 g fat, 6.41 g carbohydrate, 3.4 g fiber gives 33 calories plus mineral elements (calcium, iron, magnesium, phosphorus, potassium, sodium, copper and manganese) and a range of vitamins( C, B1, B2, B3) [1]. It is important in improving the soil's natural, chemical and vital properties [2]. The agricultural cycles is important to increase the soil fertility and stabilization of nitrogen [3,4]. It is known that the plants of the legumes family are characterized by their ability to stabilize atmospheric nitrogen through the root nodes resulting from the infection of rhizobium [5], rhizobium bacteria and in a co-existing way as legumes are equipped with nitrogen in ammonia form used in events The different vitality of the plant [6]. Green beans are considered to be legumes plants that are inactive of the nitrogen stabilization so it has been found that the addition of cobalt gives good results through the activation of enzymes that help increase the activity of vitamin B12. What matters is in the work of bacteria installed for the atmospheric nitrogen Biological [7].

many studies confirmed the role of Mulching and cobalt addition in improving the growth and yield, [8], he indicated when treating bean plants in the stage of three real leaves With irrigation water with different concentrations of cobalt (0.4, 8, 12,16,20) ppm, the concentrations exceeded 12.16 ppm significantly in plant height, the number of leaves, soft and dry weight of the vegetable, total and the yield of pods, and between [9], to add Cobalt with a concentration of 20 ppm caused a significant increase in the number of pods in the plant and in the total crop of seeds, the soil mulching with black cover gave significant differences in the number of pods in the plant, the length and diameter of the pod, the number of seeds in the pod and the total yield of the pods. Because of the lack of studies in in Iraq about the impact of cobalt addition, soil Mulching. Therefore the study was conducted in Basra province to study the soil Mulching in different types in the growth and yield of bean plants grown in plastic houses conditions of Basra.
2. Materials and Methods

The experiment was carried out during the winter season 2021-2020 Faculty of Agriculture at Basra University, where the land of the plastic house was well plowed and sterilized by solar sterilization and then irrigated. The soil was ploughed to prepare and divided. Then add the decomposing cattle residues to the lines before planting and while preparing the soil of chemical fertilizer was added super calcium phosphate (45%) at the rate of 27 kg to each plastic house\(^1\), the irrigation system was installed drip system, the seeds were grown directly on 2020/10/15, at a depth of 6 cm and Mulching was prepared with holes, then cobalt added with irrigation system after 2 weeks of planting, NPK fertilizers were added based on recommendation with irrigation system.

Study included 2 factors, the first factor Mulching with 4 levels (black, white, transparent, without Mulching) and the second factor cobalt addition with three concentrations (5, 10 mgL\(^{-1}\) and control), and the experimental units was 36 units. The experiment was conducted based on split plot according to (R.C.B.D.) design, where the main plot types of soil Mulching, while the sub plot cobalt levels. The results of the statistically analyzed and compared to L.S.D test at the level of 0.05 [10], using genstat 2008 statistical analysis.

3. Results and Discussion

Table 1,2,3,4 showed that soil Mulching, cobalt addition and overlap between them significantly affected on studied parameters, the Mulching of white plastic has been achieved the best value in Plant highest, Number of leaves plant\(^{-1}\), leave area (dcm2), Weight of the pod (plant\(^{-1}\)), Protein ratio in seeds (%).The plant yield of pods (g) while the black mulching recorded the best value in leave area, Number of pods, the cobalt concentration of 5 mg.L\(^{-1}\) achieved the highest values in Plant highest, Number of leaves plant\(^{-1}\), Root nodes number\(^{-1}\), Number of pods, Protein ratio in seeds, while the concentration 10 mg.L\(^{-1}\) achieved the best values in Leave area, Pods Weight, yield of plant g. Tables 1,2,3,4 confirmed that overlap interaction recorded a significant affect in most of study parameters, the treatment of white mulching *Cobalt 10 mg.L\(^{-1}\) achieved the best value in Plant height, Number of leaves, leave area, Pods Weight, The yield of plant while the treatment mg.L\(^{-1}\) *Black mulching achieved the highest value in number of root nodes and Number of pods.

Table 1. The effect of Mulching and cobalt treatment in plant height (cm) and the number of leaves (plant leaf\(^{-1}\)) for green beans.

| Transaction | Plant height (cm) | Number of leaves plant\(^{-1}\) |
|-------------|------------------|-------------------------------|
| without Mulching | 248.6 | 19.44 |
| Transparent | 255.1 | 18.56 |
| White | 285.3 | 24.00 |
| Black | 267.0 | 22.78 |
| LSD (0.05) | 11.11 | 1.38 |
| Zero | 253.8 | 17.42 |
| Cobalt mgl.L\(^{-1}\) | | |
| 5 | 271.6 | 23.17 |
| 10 | 266.7 | 23.00 |
| LSD (0.05) | 11.24 | 1.49 |
| without Mulching | 209.7 | 15 |
| 5 | 249.0 | 21 |
| 10 | 287.0 | 22.33 |
| Zero | 250.0 | 17.67 |
| 5 | 279.7 | 20 |
| Transparent | | |
| 10 | 235.7 | 18 |
| Zero | 274.7 | 18 |
| 5 | 289.0 | 25.33 |
| Overlap between Mulching and Cobalt | | |
| White | | |
| 10 | 292.3 | 28.67 |
| Zero | 280.7 | 19 |
| Black | | |
| 5 | 268.7 | 26.33 |
| 10 | 251.7 | 23 |
| LSD (0.05) | 20.29 | 2.67 |
Table 2. The effect of Mulching, cobalt spraying and their overlaps in the leave area (cm$^2$ plant$^{-1}$) and the number of root nodes (plant$^{-1}$) of green beans.

| Transaction                        | Leave area cm$^2$ | Root nodes number$^{-1}$ |
|------------------------------------|-------------------|--------------------------|
|                                    | without Mulching  |                         |
| Mulching                           |                   |                          |
| Transparent                        | 28.91             | 23.89                    |
| White                              | 19.64             | 20.44                    |
| Black                              | 45.22             | 21.44                    |
| Black                              | 41.42             | 21.78                    |
| LSD (0.05)                         | 4.76              | NS                       |
| Cobalt ml.L$^{-1}$                 |                   |                          |
| Zero                               | 25.49             | 7.33                     |
| 5                                  | 37.69             | 32                       |
| 10                                 | 38.21             | 25                       |
| LSD (0.05)                         | 4.31              | 4.63                     |
|                                      | Zero              | 21.55                    |
| without Mulching                   | 26.45             | 7.67                     |
| 5                                  | 26.74             | 38                       |
| Zero                               | 21.40             | 7.33                     |
| 5                                  | 17.13             | 45                       |
| Transparent                        | 10                | 20.37                    |
| Zero                               | 27.56             | 7.33                     |
| 5                                  | 49.49             | 32                       |
| Overlap between Mulching and Cobalt|                   |                          |
| White                              |                    |                          |
| Zero                               | 58.63             | 25                       |
| 10                                 | 58.63             | 25                       |
| Zero                               | 31.45             | 6.67                     |
| 5                                  | 57.70             | 41.33                    |
| Black                              | 35.12             | 17.33                    |
| LSD (0.05)                         | 7.99              | 8.27                     |

Table 3. The effect of Mulching, cobalt spraying and their overlaps in the total number of pods (plant$^{-1}$) and the weight of the pod (plant$^{-1}$) of green beans.

| Transaction                        | Number of pods | Pods Weight (plant$^{-1}$) |
|------------------------------------|----------------|-----------------------------|
|                                    | without Mulching|                         |
| Mulching                           |                |                            |
| Transparent                        | 20.11          | 7.72                       |
| White                              | 20             | 7.10                       |
| Black                              | 23.22          | 8.74                       |
| Black                              | 27.22          | 7.90                       |
| LSD (0.05)                         | 2.27            | 0.98                       |
| Cobalt ml.L$^{-1}$                 |                |                            |
| Zero                               | 20.83          | 7.20                       |
| 5                                  | 25.50          | 7.84                       |
| 10                                 | 21.58          | 8.55                       |
| LSD (0.05)                         | 3.19            | 0.84                       |
|                                      | Zero            | 22.67                      |
| without Mulching                   | 5              | 6.07                       |
| 10                                 | 21.67          | 7.75                       |
| Zero                               | 16             | 9.33                       |
| 5                                  | 18.67          | 7.19                       |
| 10                                 | 21.33          | 7.05                       |
| Transparent                        | 10             | 7.07                       |
| Zero                               | 20             | 7.67                       |
| 5                                  | 20.67          | 8.41                       |
| Overlap between Mulching and Cobalt|                |                            |
| White                              |                |                            |
| Zero                               | 22             | 7.86                       |
| 5                                  | 38.33          | 8.15                       |
| 10                                 | 21.33          | 7.68                       |
| LSD (0.05)                         | 5.48            | NS                         |
Table 4. The effect of Mulching, cobalt spraying and their interference in the protein ratio in seeds and the yield of one plant green pods for green beans.

| Transaction | Protein ratio in seeds (%) | The yield of plant g |
|-------------|-----------------------------|----------------------|
| without Mulching | Transparent | 11.41 | 149.2 |
| | White | 11.75 | 141.1 |
| | Black | 20.71 | 200.2 |
| | LSD (0.05) | 10.86 | 181.2 |
| | Zero | 1.11 | 30.34 |
| | 5 | 13.92 | 148.6 |
| | 10 | 15.05 | 174.4 |
| | LSD (0.05) | 12.08 | 180.8 |
| Cobalt ml.L⁻¹ | 0.72 | 13.16 |
| | 5 | 8.28 | 137.3 |
| | 10 | 12.31 | 166.3 |
| | LSD (0.05) | 12.65 | 144.0 |
| | Zero | 12.50 | 134.5 |
| | 5 | 9.89 | 148.0 |
| Transparent | 10 | 12.86 | 141.3 |
| | LSD (0.05) | 10 | 14.53 |
| | Zero | 25.73 | 153.3 |
| | 5 | 24.50 | 173.3 |
| Overlap between Mulching and Cobalt | 1.50 | 34.29 |
| White | 10 | 11.90 | 274.0 |
| | LSD (0.05) | 9.18 | 169.7 |
| | Zero | 12.50 | 210.0 |
| | 5 | 10.90 | 164.0 |
| Black | 10 | 1.50 | 34.29 |

Tables (1,2) show that Mulching has had a significant impact on plant height, number of leaves and paper area, that may be due to soil Mulching increases the temperature, which stimulates the total radical to increase the absorption of water and nutrients which produced the plant hormones such as gibberellins and cytokines that have an impact on the strength of vegetable growth [11]. The Mulching reduces moisture loss due to maintaining a regular soil content along the soil and depths, which provides a suitable conditions for the growth of roots as well as reducing the growth of weeds [12,13], which accelerates the growth of the soil. The addition of cobalt has significantly affected in plant height, number of leaves and leave area, may be due to the role of cobalt, which inhibits the action of ethylene and increases the efficiency of growth-promoting hormones such as Auxins, Gibberellins and cytokines and improved readiness and movement of nutrients [14], which has positively affected the characteristics of the vegetative group. Cobalt also reduces the loss of water from leaves by preventing Wilted and increasing the efficiency of water consumption within plant cell tissues,. These results are consistent with his findings [15-18].

Cobalt has significantly affected the number of nodes and the increase in the number of root nodes may be attributed to the role of cobalt, involved in the formation of vitamin B12, which is important in the formation of root nodes on the roots of legumes plants, thereby increasing the number of root nodes in plants, which the plant's ability to stabilize atmospheric nitrogen increases [19], as well as for the role of cobalt In its participation in many physiological and chemical processes that take place within the plant, which reflected the increased ability of the plant to absorb nutrients and make it easier to distribute to the constituent estuaries [20], by increasing plant height leave area (Table 1 and 2) in succession, which has positively affected the yield (tables 3,4).

Tables (3,4) clear that Mulching affected on the yield parameters, may be due to these differences because the Mulching provided a suitable conditions s for plant growth through, improving its physical and chemical properties, and increasing their ability to retain water and nutrients and facilitate their absorption by the plant [21-23].
Conclusions

The white and Black mulching have been achieved the highest values in yield parameters compared to other mulching, both of cobalt concentrations 5 and 10 mg L\(^{-1}\) achieved the best results compared to control treatment.

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