The Effect of Humic Acid Addition Stages and Planting Times in Some Components and Yield of Zea mays L.

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Abstract. A field experiment was carried out for the spring and autumn seasons 2020 in Rawwa district, located at longitude: E ° 41.57 Latitude: N ° 34.46 and at a height of 150m above sea level, to study the effect of the stages of adding humic acid and planting times on the growth and yield of Zea mays L., Varieties 5018, the first factor occupied the phases of adding humic acid and the second the planting times. A split-plot design (RCBD) was used with three replications to find out the effect of the humic acid addition stages (S1, S2, S3 and S4). And planting times (D1, D2, D3) in the yield and its components. The results showed significant differences between all study factors and the interaction between them, except for the number of rows and for the spring season only, where the treatment S2 outperformed in the two characteristics of the length of cob: cm and the number of kernels row, as it gave 16.62, 18.44 cob. Cm, 36.22 and 35.23 grains. Row\(^{-1}\) and the two seasons respectively, while treatment S4 outperformed in terms of weight of 500 grains and the total, with 119.10 and 162.64 grains, gm and 8.74 Mg.H\(^{-1}\)for the spring season, while the treatment surpassed S3 and gave 11.98 Mg.H\(^{-1}\) for the autumn season. As for the planting times, the time D1 was distinguished in the characteristics of the number of rows, the number of grains in the row, and the weight of 500 grains, as it gave 16.38 rows. Cob\(^{-1}\) and 36.92 grains. Row\(^{-1}\) and 120.17 gm, weighing 500 gm for the spring season. The two times D3 and D2 were also higher in She described the weight of 500 grains and the total and gave 173.85 grains of grams for the spring season and 8.57 and 10.98 Mg.H\(^{-1}\) for the two seasons, the interaction between study factors had statistically significant differences in the two seasons, where the combinations D1 and S3, D2 and S4, D3 and S3 outperformed as they gave 16.63 rows. Cob\(^{-1}\), 38.23 grains, row\(^{-1}\), 128.03500 grains, gm, 9.47 and 13.43 Mg.H\(^{-1}\), 17.33 cm length of Cob, respectively and for the two seasons.

1. Introduction

Zea mays L. is one of the important cereal crops that belong to the Poaceae family, as it ranks third in terms of cultivated area and production after the wheat and rice crops, [1]. The cultivated area in Iraq for the year 2016 was (76,000) hectares. With an average production of (3,416) Mg.H\(^{-1}\) [6], Zea mays L. grains contain (81%) carbohydrates and (10.6%) crude protein, (4.6%) oil and (2%) ash, and they also contain vitamin E, B1, B2, so the importance of this crop lies in its multiple uses as it is used as food for humans in addition to its entry into many industries where it is used as green fodder or silage in livestock feeding. It can also be used as poultry feed in the concentrated diet as it is included in the medical uses of some diseases as a treatment for kidney stones. And reduce blood pressure and sugar, as leaves and stems are used in the manufacture of dyes and papers and the biofuels industry as a substitute for car fuel [2]. Zea mays L. is a depleted crop due to its high ability to absorb nutrients in large quantities during the growing period [3]. Therefore, the thought was to use alternatives to chemical fertilizers as the overuse of them leads to the occurrence of environmental pollution as a result of disturbing the carcinogenic environmental balance [3]. Those interested in the agricultural field to provide the necessary nutrients for the plant in appropriate quantities and times to increase the yield per unit area, [4]. Among the techniques that are used as an alternative to chemical fertilizers is the use of organic fertilizers, including humic acid [5], which is a humic substance consisting of many compounds of high molecular weights united with each other and with an unknown chemical composition and contains large numbers of active groups, [6], and it is produced from chemical and biological processes in the soil, which works to improve the chemical, physical and biological properties in it, as it provides the necessary nutrients for the plant due to its ability to mix many of them and increase its readiness for the plant in addition to increasing the ability of the soil to retain water as well as its ability to stimulate societies Bioassays and their growth in soil [7]. It also works to increase the readiness of trace elements such as iron, zinc and manganese in the soil, as it works to chelate them and prevent them from combining with the phosphate group to form insoluble compounds [8]. It greatly affects the length of the flowering period of [9], and the time of planting is one of the foundations on which the cultivation
of Zea mays L. is based, due to the coincidence of appropriate temperatures with the different stages of plant growth.\cite{10}, As plants in the initiation phase are exposed to cold when planting early in the spring season and to high temperatures when flowering in late planting, which negatively affects germination, pollination and fertilization processes, and thus leads to a decrease in the initial yield \cite{11}, but in the autumn season, the seedlings are exposed to heat High humidity during early sowing, and rotting seeds when planting is late.

Therefore, this study came to determine the best stage for adding organic fertilizer, which gives the highest yield in quantity, reduces pollution and determines the best time that gives a high yield and reduces the percentage of rot and self-germination in the seeds.

2. Materials and methods

A field experiment was carried out in the spring and autumn seasons of 2020 in Rawa district, located at longitude : E ° 41.57 Latitude: N ° 34.46 and at a height of 150m above sea level, to study the effect of the stages of adding humic acid and planting times on the growth and yield of Zea mays L., Variety (5018), the first factor. The phases of adding humic acid and the second planting times, RCBD was used in split-plot arrangement with three replications. The main plot included the planting times, which were denoted by the symbol D1, D2, and D3 in the sequence (1 March, 15 March, 1 April) for the spring season and (1 July, 15 July, 1 August) for the autumn season, while the secondary plot (sub-plot) included the stages of adding organic fertilizer (Humic) at a rate of 24 kg.h\textsuperscript{1} \cite{11}, which were represented in four stages: S1 without addition (control), S2 addition at the stage of the fourth leaf is complete and real, and S3 addition at the stage of the eighth leaf is complete and true, and S4 addition at the stage of the twelfth leaf and before flowering is complete and true, where it was added by dissolving fertilizer with (3) liters of distilled water a day before adding to each experimental unit and adding it by making an incision next to the planting line and covering it with field soil. Random samples were taken from the field soil before planting at three different depths (0-30) cm to study some Its chemical and physical properties have been placed in Table (1).

Table (1) shows the chemical and physical characteristics of field soil

| Characteristic         | Unit | Value | Characteristic | Unit | Value |
|------------------------|------|-------|----------------|------|-------|
| Sand                   | %    | 29    | Ca\textsuperscript{2+} | Mg.L\textsuperscript{-1} | 425   |
| Silt                   | %    | 51    | Mg\textsuperscript{2+} | Mg.L\textsuperscript{-1} | 198   |
| Clay                   | %    | 20    | Na\textsuperscript{+}  | Mg.L\textsuperscript{-1} | 520   |
| Bulk density           | g. cm\textsuperscript{-1} | 1.45  | K\textsuperscript{+}   | Mg.L\textsuperscript{-1} | 39.8  |
| EC 1: 1 (1: 1 extract) | dc.m\textsuperscript{-1} | 2.87  | CL\textsuperscript{-1}  | Mg.L\textsuperscript{-1} | 995   |
| PH                     |       | 7.39  | SO\textsubscript{4}\textsuperscript{2-} | Mg.L\textsuperscript{-1} | 929   |
| Caco3 (Lime)           | %    | 26.2  | Hco3            | Mg.L\textsuperscript{-1} | 418   |
| Organic Matter O.M     | %    | 1.16  | No3             | Mg.L\textsuperscript{-1} | 45    |
| Available Nitrogen     | Mg.kg\textsuperscript{-1} | 69    |                 |       |
| Available Phosphorous  | Mg.kg\textsuperscript{-1} | 12.3  | Available Potassium | Mg.kg\textsuperscript{-1} | 168   |

Soil mixed according to the tissue triangle (alluvial mixture)

Table (2) analysis of humic fertilizer.

| N% | P% | K% | O.M% |
|----|----|----|------|
The experiment land was plowed by two perpendicular plows, then it was flattened, and after the completion of the leveling and adjustment operations, the experiment land was divided into experimental units of an area of \((12) \text{ m}^2\) with dimensions \((3 \times 4) \text{ m}\), where the experimental unit was planted on the lines of the distance between one line and another 60 cm and the secondary panels were isolated from each other with a distance of 1 m to prevent the leakage of fertilizer between treatments, add the ready-made compound fertilizer \((\text{N}:\text{P}_2\text{O}_5:\text{K}_2\text{O})\) at a concentration of \((15:15:15)\) in one batch before planting so as not Interfere with the addition of organic fertilizer at a rate of \((400) \text{ kg.H}^{-1}\), The addition process was carried out by spreading the compost and covering it with the field soil, the planting was done by hand according to the dates of planting prepared in a schedule by placing \((2-3) \text{ seeds}\) in the hole at a depth of 3-5 cm, after which the experiment was watered and then the field was patched to complete the germination after a week of emergence then the plants were loosened to one plant in the hole at the third leaf stage, the test ground was planted manually three times during the season until the plant height, the granulated diazinon pesticide was used at a concentration of \((10\%)\) according to the recommendation to combat the stem borer insect, where it is added by feeding the growing top of the plant by the amount of \((6) \text{ Kg.H}^{-1}\), with two batches, the first is protective for the plant in the third leaf stage and the second is precautionary, after the plant reaches the sixth leaf stage, the spring season plants planted on \((1 \text{ March, 15 March,1 April})\) On \((16 \text{ July, 21 July, and 28 July})\) respectively, I harvested the plants of the autumn season planted on \((1 \text{ July, 15July, and 1 August})\) on \((20 \text{ October, 31 October and 20 November})\) respectively. Ten plants were taken from each experimental unit. The following characteristics were averaged:

1. The length of cob: cm
2. Number of rows in cob: row. Cob \(^{-1}\)
3. Number of grains in the row (grain, row \(^{-1}\)).
4. Weight of 500 grains: (gm).
5. Total grain yield: tons. Ha\(^{-1}\): Calculate from the following equation the yield of one plant \(\times\) the plant density \([10]\).

2.1 Statistical analysis
The data were analyzed statistically according to the ready-to-use Genstat program for statistical analysis. The arithmetic averages were compared using the least significant difference L.S.D with a probability level of 0.05.

3. Results and discussions

3.1 The length of Cob: (Cm)

The results of Table (3) show the superiority of treatment S2, as it achieved the highest average length of cob \((16.62, 18.44) \text{ cm}\) for the spring and autumn seasons respectively, compared to the comparison treatment S1, which gave the lowest average length of Cob was \((15.16, 16.89) \text{ cm}\) for the spring and autumn seasons. In a row, the reason for the increase may be attributed to the role of humic acid in providing nutrients to the plant in addition to the increase in the activity of acetic acid, which helps the growth of plants and which positively affects the process of photosynthesis and thus is reflected along the saltiness of \([6]\), and this is in agreement with \([1,14]\), as shown in the same table that the characteristic of the length of the spike was not affected by the planting times in the spring season, but in the autumn season the time D3 exceeded, as it gave the highest average length of Cob \((18.43) \text{ cm}\) compared to the time D2, which gave the lowest average length Cob reached \((17.54) \text{ cm}\), and the reason is due to the increase in the leaf area, the interception of the largest amount of light and the activity of the photosynthesis process, and thus the increase in the length of the Cob \([15]\), and this is consistent with \([16]\), as the table shows the presence of a significant effect of interference For between the phases of adding humic acid and planting times for the spring and autumn seasons, in the spring season the
treatment S3 and D3 outperformed, as it achieved the highest average length of (17.33) cm, compared to the treatment D1, S1, which gave the lowest average length of (14.20) cm. In the fall season, the interaction between treatment D3, S4 achieved the highest average length of Cob which reached (19.00) cm, compared to treatment D2, S1 which gave the lowest average length of (15.90) cm.

Table 3. Effect of the stages of adding humic fertilizer, planting time, and the interaction between them in length of cob (cm).

| Spring season | Autumn season |
|---------------|---------------|
| S1            | S2            | S3            | S4            | Average | S1            | S2            | S3            | S4            | Average |
| D1            | 14.20b        | 15.97ab       | 16.73a        | 16.07a        | 15.74   | D1            | 16.87d        | 18.60a        | 17.87bc      | 17.67c 17.75c |
| D2            | 15.50bc       | 16.93a        | 15.73a        | 17.03a        | 16.30   | D2            | 15.90c        | 18.30abc      | 17.63c       | 18.33bc 17.54b |
| D3            | 15.77bc       | 16.97a        | 17.33a        | 16.67a        | 16.68   | D3            | 17.90bc       | 18.43b        | 18.37bc      | 19.00c 18.43a |
| Average       | 15.16b        | 16.62a        | 16.60a        | 15.59c        |         | Average       | 16.89c        | 18.44a        | 17.96b       | 18.33ab |
| L.S.D. 0.05   | D             | S             | D*S           |               |         | L.S.D. 0.05   | 0.476         | 0.410         | 0.710        |

* N.S.: Non-Significant
a, b, c: means in the same Rows with different superscripts differ significantly at probability value 0.01 and 0.05.

3.2. Number of rows in Cob: (Row. Cob⁻¹)

The results of Table (4) indicate that the number of rows in Cob was not affected by the stages of adding humic fertilizer in the spring season, but in the autumn season, treatment S3 outperformed, as the highest average number of rows in Cob was recorded (16.01) rows. Cob⁻¹ It gave the lowest average number of rows in Cob, which was (15.11) rows. Cob⁻¹, and the reason may be attributed to the positive effect of humic acid in improving the chemical and physical properties of the soil and providing the necessary elements for growth that lead to activating the biological processes in plants and activating the photosynthesis process, the formation of sugars and the manufacture of Food and thus an increase in the number of rows in Cob. [1], and these results are consistent with the findings of [17,18]. The same table also showed that the characteristic of the number of rows in Cob was not affected by the planting times in the spring season, either in the fall season has exceeded the time D1, as it achieved the highest average number of classes in Cob, which reached (16.38) rows. Cob⁻¹ compared to the time D2, which gave the lowest average number of classes in Cob, which reached (15.27) rows. Cob⁻¹, and the reason may be attributed to the environmental conditions Fit during flowering period As the high relative humidity is a result of moderation in temperatures and thus the success of the pollination process and fertilization due to the lack of drying of the pollen, which positively affected the increase in the number of rows in Cob [20], and these results are consistent with what was reported by [19,20,21], and the same table showed that there was a significant effect of the interaction between the stages of adding humic acid and the planting dates on the characteristic of the number of rows in the cob for the spring and autumn seasons. In the spring season, the treatment D2, S2 exceeded, as it gave the highest average number of rows in Cob reached (17.23) rows. Cob⁻¹, compared to the treatment D1, S1, which gave the lowest average number of rows in Cob, which was (15.70) rows. Cob⁻¹, while in the autumn season, the treatment D1, S3 surpassed, as it achieved the highest average number of classes in Cob. It reached (16.63) rows. Cob⁻¹ compared to the treatment D2, S1, which gave the lowest average number of rows in Cob, which reached (14.60) rows. Cob⁻¹.
Table 4. The effect of the stages of adding humic fertilizer, planting dates, and the interaction between them in the number of rows in cob: (row. Cob $^{-1}$).

|                  | Spring season |         |         |         | Autumn season |         |         |         |         |
|------------------|---------------|---------|---------|---------|---------------|---------|---------|---------|---------|
|                  | S1            | S2      | S3      | S4      | Average       | S1      | S2      | S3      | S4      | Average       |
|                  | D1            | D2      | D3      |         |               | D1      | D2      | D3      |         |               |
|                  | 15.70$^{ab}$  | 16.17$^{ab}$  | 15.83$^{b}$  | 16.13       |               | 15.97$^{ab}$  | 16.47$^{a}$  | 16.63$^{a}$  | 16.47$^{a}$  | 16.38$^{a}$          |
|                  | 16.63$^{ab}$  | 17.23$^{a}$  | 16.90$^{b}$  | 16.38       |               | 14.60$^{c}$  | 15.60$^{bc}$  | 15.23$^{bc}$  | 15.63$^{bc}$  | 15.27$^{b}$          |
|                  | 15.87$^{ab}$  | 16.30$^{ab}$  | 16.07$^{a}$  | 16.09       |               | 14.77$^{c}$  | 15.37$^{bc}$  | 16.17$^{ab}$  | 15.57$^{ab}$  | 15.47$^{b}$          |
|                  |               |         |         |         | Average       |         |         |         |         | Average       |
|                  |               |         |         |         |               |         |         |         |         |               |
|                  | 16.07$^{a}$   | 16.51$^{a}$  | 16.27$^{a}$  | 16.53       |               | 15.11$^{a}$  | 15.81$^{a}$  | 16.01$^{a}$  | 15.89$^{a}$          |
|                  |               |         |         |         |               |         |         |         |         |               |
|                  | 0.8465        | 0.592   | 1.0918                                |
| L.S.D 0.05       | 1.279         |         |         | N.S       |               |         |         |         |         |               |

*$^*$ N.S.: Non-Significant

a, b, c: means in the same rows with different superscripts differ significantly at probability value 0.01 and 0.05.

3.3. Number of grains in a row: a grain. Row $^{-1}$

The results of Table No. (5) showed the superiority of treatment S2 in the spring and autumn seasons, as it recorded the highest average number of pills in a row with (36.22 and 35.23) grains. Row $^{-1}$ for the spring and autumn seasons, respectively, compared to treatment S1, which gave the lowest average number of pills in the row. (32.99 and 30.40) grains. Row $^{-1}$ for the spring and autumn seasons respectively, and the reason may be attributed to the effectiveness of humic acid in preparing the plant with the elements necessary for growth such as phosphorus and nitrogen that help the activity of photosynthesis and thus increase the processed food, which positively affects the increase in the number of grains in the row. [1], and these results are consistent with what was reported by [22, 23]. The same table also clarified that the characteristic of the number of grains in a row was not affected by the planting times in the spring season, either in The autumn season exceeded the time D1, as it achieved the highest average number of grains in the row, which reached (36.92) grains, Row $^{-1}$ compared to the time D2, which gave the lowest average number of grains in the row of (31.27) grains, Row $^{-1}$, and the reason may be attributed to the temperature And appropriate humidity during the flowering stage, which increased the efficiency of the pollination process and fertilization To increase the number of grains in the row, and this is consistent with what [24] reported, and from the results of the same table shows the significant effect of the interaction between the stages of adding humic fertilizer and planting times on the characteristic of the number of grains in the row in the spring and autumn seasons, in the spring season the treatment exceeded D1, S3, as it recorded the highest average number of grains in the class, it reached (38.23) grains. Row $^{-1}$ compared to treatment D1, S1, which gave the lowest average number of grains in the row, reached (30.20) grains. Row $^{-1}$, but in the autumn season the treatment exceeded D1, S2, as it achieved the highest average number of pills in the class, which reached (39.53) grains. Row $^{-1}$, compared to treatment D2, S1, as it gave the lowest average number of pills in the class of (26.40) grains. Row $^{-1}$.

Table 5. The effect of the stages of adding humic fertilizer, planting dates, and the interaction between them in the number of grains in the row (grain. row $^{-1}$).

|                  | Spring season |         |         |         | Autumn season |         |         |         |         |
|------------------|---------------|---------|---------|---------|---------------|---------|---------|---------|---------|
|                  | S1            | S2      | S3      | S4      | Average       | S1      | S2      | S3      | S4      | Average       |
|                  | D1            | D2      | D3      |         |               | D1      | D2      | D3      |         |               |
|                  | 30.20$^{ab}$  | 35.33$^{ab}$  | 38.23$^{a}$  | 35.97$^{ab}$  | 34.93$^{ab}$  | 34.30$^{ab}$  | 39.53$^{ab}$  | 37.37$^{ab}$  | 36.47$^{bc}$  | 36.92$^{a}$          |

*$^*$ N.S.: Non-Significant

a, b, c: means in the same rows with different superscripts differ significantly at probability value 0.01 and 0.05.
### 3.4. Weight of 500 tablet (gm)

The results of Table No. (6) show the superiority of treatment S4 as it achieved the highest average weight of 500 grains (119.10, 162.64) gm for the spring and autumn seasons respectively, compared to treatment S1, which gave the lowest average weight of 500 grains of (108.10, 151.20) gm. For the spring and autumn seasons respectively, and the reason may be attributed to the increase in the size of the bean and the heaviness of its weight as a result of raising the efficiency of the photosynthesis process by humic acid and increasing the foodstuffs manufactured inside the plant and its transfer to the grains of [21], and this result is consistent with what [7], have reached. as shown in the same table, the weight of 500 grains was affected by the planting times in the spring and autumn seasons. In the spring season, the time D1, which gave the highest average weight of 500 grains, was (120.17) g, compared to time D3, which gave the lowest average weight of 500 grains, which reached (100.27) gm, and this result is consistent with what [25]. The same table also showed the presence of a significant effect of the interaction between the stages of adding humic fertilizer and the planting times in the characteristic of Weighing 500 grains for the spring and autumn seasons. In the spring season, treatment D2, S4 outperformed, as it gave the highest average weight of 500 grains, which was (128.03) g, compared to treatment D3, S1, which gave the lowest average weight of 500 grains, which was (100.27) gm, but in the autumn season it excelled Treatment D3, S4 gave the highest average weight of 500 tablets, which was (182.50) g, compared to treatment D1, S1, which gave the lowest average weight of 500 tablets, which was (142.10) g.

|                  | Spring season                                      | Autumn season                                     |
|------------------|---------------------------------------------------|--------------------------------------------------|
|                  | D1  | D2  | D3  | Average | D1  | D2  | D3  | Average |
| S1               | 110.60<sup>ab</sup> | 113.43<sup>ab</sup> | 100.27<sup>ab</sup> | 112.15<sup>a</sup> | 142.10<sup>ab</sup> | 146.53<sup>ab</sup> | 164.97<sup>ab</sup> | 151.20<sup>a</sup> |
| S2               | 124.37<sup>ab</sup> | 120.47<sup>ab</sup> | 108.47<sup>ab</sup> | 120.17<sup>a</sup> | 144.43<sup>ab</sup> | 158.30<sup>ab</sup> | 178.50<sup>a</sup> | 160.41<sup>ab</sup> |
| S3               | 124.63<sup>ab</sup> | 120.47<sup>ab</sup> | 110.27<sup>ab</sup> | 121.07<sup>a</sup> | 143.70<sup>ab</sup> | 160.53<sup>ab</sup> | 182.50<sup>a</sup> | 160.84<sup>ab</sup> |
| S4               | 121.07<sup>a</sup> | 128.03<sup>ab</sup> | 108.20<sup>ab</sup> | 121.07<sup>a</sup> | 145.50<sup>ab</sup> | 159.93<sup>ab</sup> | 173.85<sup>a</sup> | 157.89<sup>ab</sup> |
| Average          | 112.15<sup>a</sup> | 120.17<sup>a</sup> | 108.20<sup>ab</sup> | 119.10<sup>a</sup> | 143.93<sup>c</sup> | 156.33<sup>c</sup> | 173.85<sup>a</sup> | 162.64<sup>a</sup> |

* N.S.: Non-Significant

a, b, c: means in the same Rows with different superscripts differ significantly at probability value 0.01 and 0.05.
3.5. Total grain yield: Mg.H⁻¹

The results of Table (7) show that the total yield was affected by the stages of adding humic fertilizer in the spring and autumn seasons. In the spring season, treatment S4 outperformed as it gave the highest average grain yield of (8.74) Mg.H⁻¹ compared to treatment S1, which gave the lowest average grain yield. (7.36) Mg.H⁻¹, but in the autumn season, treatment S3 surpassed, as it achieved the highest average grain yield of (11.98) Mg.H⁻¹ compared to treatment S1, which gave the lowest average grain yield of (8.30) Mg.H⁻¹. The reason may be attributed to the ability of humic acid to provide the plant with the elements necessary for growth that help to improve the growth of the shoots and increase the transport of nutrients from the source to the downstream and thus increase the yield of [3], and these results are consistent with what have found [13], as the results of the same table showed that the total yield was affected by the planting times of the spring and autumn seasons, in the spring season the time D2 exceeded, as it achieved the highest average grain yield of (8.57) Mg.H⁻¹ compared to the time D3, which gave the lowest average grain yield of (7.68) Mg.H⁻¹, but in the autumn season it exceeded the target D3, which achieved a higher average grain yield (10.98) Mg.H⁻¹ compared to time D2, which gave the lowest average grain yield of (9.24) Mg.H⁻¹, and the reason may be attributed to the appropriate environmental conditions such as temperature and humidity that helped the fertilization process and which led to an increase in the yield components such as the length of spinach, in addition to the length of the filling period, which led to an increase in the weight of the grains and thus increased the total yield of Lafta and Yehia (2019), and these results are consistent with what was reported by [24,16,4], as the same table showed that there was a significant effect of the interaction between the addition of humic fertilizer and planting times on the characteristic of total grain yield in the spring and autumn seasons. In the spring season, the treatment D2, S4 surpassed, as it recorded the highest average grain yield of (9.47) Mg.H⁻¹ compared to the treatment D3, S1, which gave the lowest average grain yield of (7.00) Mg.H⁻¹, and the reason may be due to the increase in the weight of the grains and thus the increase in the yield weight. In the autumn season, treatment D3, S3 outperformed, as it gave the highest average grain yield Cereals reached it reached (13.43) Mg.H⁻¹ compared to treatment D2, S1, which gave the lowest average grain yield it reached (6.33) Mg.H⁻¹.

Table 7. The effect of the stages of adding humus fertilizer and the planting times and the interaction between them in the total grain yield (Mg.H⁻¹).

| Spring season | Autumn season |
|---------------|---------------|
| S1 | S2 | S3 | S4 | Average | S1 | S2 | S3 | S4 | Average |
| D1 | 7.10e | 8.87bc | 9.13ab | 8.73c | 8.46a | D1 | 9.17e | 11.77b | 11.90b | 10.4010.81a |
| D2 | 7.97d | 8.77b | 8.07d | 9.47a | 8.57c | D2 | 6.33f | 10.6010.60c | 9.43c | 9.24b |
| D3 | 7.00e | 7.97d | 7.73d | 8.03d | 7.68b | D3 | 9.40e | 10.20c | 13.43c | 10.87c | 10.98c |
| Average | 7.36c | 8.53c | 8.31b | 7.84c | | Average | 8.30d | 10.86c | 11.98c | 10.23c |
| L.S.D 0.05 | D | S | D*S | L.S.D 0.05 | D | S | D*S |
| 0.3685 | 0.2116 | 0.3665 | 0.509 | 0.436 | 0.751 |

a, b, c: means in the same Rows with different superscripts differ significantly at probability value 0.01 and 0.05.
4. Conclusion

We recommend the adoption of the fertilizer stages S4 and S3 because it surpassed the total yield characteristics and the most important components of it for the two seasons respectively. We recommend the adoption of season D2 and D3 because it outperformed in characteristics of the total yield, the weight of 500 grains, and the length of cob, and for the two seasons respectively.

References

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