Foliar application of IAA at different growth stages and their influenced on growth and productivity of bread Wheat (triticum aestivum l.)

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Abstract. A field experiment was conducted to study the response of bread wheat crop to indol-3-acetic acid (IAA) at variants growth stages during 2017-2018 at agronomy research farm, College of Agriculture, University of AL.qasim Green, Babylon-Iraq. Using Randomized Complete Bock Dazine(RCBD) with split plot arrangement .Man plot contained four concentration of 0, 50, 100 and 150 ppm of plant growth regulator (IAA), while sub plot consisted of three critical growth stages of namely S1(tillering. ZGS:21) S2( booting. ZGS:45 ) S3( flowering. ZGS:69 ). The data was recorded on pant height (cm) at maturity , flag leaf area(cm²), chlorophyll content (SPAD), spike length (cm),number of spike/m², number of grain /spike, 1000-grain weight (g),grain yield (t/ha⁻¹), biological yield (t/ha⁻¹). The results showed that IAA at the concentration 100 ppm produced maximum plant height (92.36cm), chlorophyll content (51.04)SPAD, spike length (14.25 cm ),number of spike/m², number of grain /spike, 1000-grain weight (36.50g),grain yield (6.61 t/ha⁻¹), biological yield (16.13 t/ha⁻¹).

Keywords: Foliar application, Indol Acetic Acid (IAA), Growth stages

1. Introduction

Cereals cultivation have occupy an important location among the agricultural crops all over the world. Wheat and barely are considered the two main crops from grain crops , especially in the aired zones, that depend on rains in the cultivation. Wheat was used as food from last hundred years ago due to their long association with man s food. Therefore, it was cultivated in large scales in the world to cope the increasing need for food and food of the people [4].To meet the increased demand for food grain of rapidly growing population, there are many yield boosting agronomic techniques like application of certain plant growth regulators which needs due attention. Although plant growth regulators have been used in agriculture for as long as crop cultivation their impact up to now has been relatively little detected and their application is limited to some specific objectives for example quality and quantity improvement [11]. hormones regulate a ariety of growth and development processes. Among the plant growth regulators auxins play an important role in hormonal activity for flower
production in plants (Kaur sawhney et al,2003).

IAA plays a major role on regulation plant growth ,for example ,it controls vascular tissue development, cell elongation, and apical dominance [14].Also IAA stimulates cell elongation by modifying certain conditions like, increase in osmotic contents of the cell, increase in permeability of water in to cell, decrease in wall pressure ,an increase in cell wall synthesis, protein synthesis and actively participates in adaptive responses of the plant to different stress factors [15].There are many factors that influence on florets primordia survivor. Longer duration of the spike growth, from terminal spikelet to anthesis, increases spike dry weight that enhances floret survival[12].Indole acetic acid is a type of auxin that stimulates growth through cell elongation and lateral root formation which probably support more absorption of minerals [2].Auxin are used commercially for enhancing crop production and regulation plant growth and development rapid growth such as shoot tissue, young leaves and developing seeds, elongation but do promote lateral root development [9]. Also auxin application increase pod numbers, seed weight or seed yield in pea. But this based on varietals sensitivalty and correct application timing [1].Reported that the application of IAA significantly increased 1000- grain weight, number of grains/ spike and spike grain yield foliar spraying with growth regulators (IAA) showed significant effect on plant [4]. showed that clodinafop- propargyl increased wheat grains per spike , 1000;grain weight and grain yield up to 92, 80, and 59 % respectively , compared to control[13]. Application of IAA at 150 ppm give the maximum values of flag leaf area,SPAD meter values, number of spike/m², spike length,grain number/ spike [5]. have made a study to cover the aspects of interaction of phytohormones on growth and development of crop plants which cause positive responses including plant height, leaf area, dry weight, chlorophyll content, seed yield , biological yield [6]. The main objective of the present study was to investigate the influence of foliar spray indole -3-acetic acid (IAA) at different growth stages on some characters wheat plants growth ,yield and its components.

2. Material And Methods

The field experiments were conducted at the Experiments Station in agriculture college , Al.Qasim Green University in Babilon ,east of Iraq (44/ N, 43/ E), during the successive winter seasons of 2017-2018 .The objective of this study was decided the effect of foliar application IAA concentrations on wheat plant The experiment was laid out in Randomized complete Block Design with split plot design with three replicates . The levels of growth regulator were allocated to main plots and plant growth stage to sub plots. The net plot size was 2x3m². Indule acetic acid 99% was applied with the help of hand pump sprayer . Four different levels of plant of plant growth regulator (IAA)concentrations ( 0, 50,100 and 150 ppm) were applied at the time of tillering stage (S₁) booting stage (S₂) flowering stage (S₃) . The full dose of phosphorus 100 kg.h⁻¹ was applied at the time of transplanting . while nitrogen 200 kg.h⁻¹ was applied in two split doses, half at the time of transplanting and remaining half at the time of panicle initiation . Seeds of IBA 99 variety .Experimental soil was a Sandy clay loam with EC dS/m at 4.6, p H 8.3, available N 28.7 and P 37 ppm. Wheat grains were broadcasted at a rate of 120 Kg /ha followed by irrigation . All the experimental plots were sprayed with tribenuron methyl herbicide at a rate of 20 g/ha after 20 days from sowing for controlling broadleaf weeds . All other recommended cultural practices, other than treatments variables, were adopted throughout the growing season . The data were recorded on plant height (cm) by selecting ten plants at random from each plot at maturity . Their height was measured from the soil surface to the tip of spike / flag leaf with the help of meter rod and average height was calculated flag leaf area was measured on 10 tillers chosen randomly from each plot .Total chlorophyll content (SPAD meter value)of flag leaf was also determined by the chlorophyll meter (SPAD -502 plus).The Soil –plant Analyses Development (SPAD) unit of Minolta Camera Co.,has developed the SPAD- 502 chlorophyll meter (Minolta Camera Co., Japan), a hand –held, self – calibrating , convenient, and non-destructive lightweight device used to calculate the amount of chlorophyll present in plant leaves [7]. Harvesting was done on 23 May
2018, where tillers of square meter per each experimental plot were collected to estimate number of spike per square meter. Afterward, 10 tillers were taken from each and spike length, number of grains/spike. From the dry seed lot of each plot, samples of 1000-grain weight (g) were taken and weighed. Paddy yield was recorded from each plot. After harvesting, the clean rough wheat was bulked and weighed at 14% moisture contents. Total biological grain yields were determined by harvesting all plants in 1.5 m² each sub-plot and converted to tons/ha.

Statistical analysis

The obtained data from each season were subjected to the proper statistical analysis of variance according to [3]. The differences among the means of different treatments were tested using the least significant differences (LSD) at probability 5%. Statistical analysis was done using the Genstat program, free version software, (USA).

3. Results and discussion

3.1. Growth parameters of wheat

Plant height (cm) at maturity in Table 1 indicated that plant growth regulator (IAA), at different growth stages. The effect of IAA on plant height of wheat is concerned, it was observed that various IAA concentration significantly affected the plant height at p > 0.05 the tallest plants (92.36 cm) were recorded in the treatment where 100 ppm of IAA was applied followed by 150 ppm application of study the smallest plants were observed in control. The application of IAA at growth stage S₁ (tillering) showed maximum plant height of (88.96 cm) the interaction of IAA and growth stage levels was also highly significant of study at the treatment 100 ppm of and S₁ (tillering) was at top with (95.93 cm) plant height. It seems to be due to intact cells elongation.

Flag leaf area and Chlorophyll content (SPAD) values (after tillering stage) were significantly affected by IAA treatments. Data in Table 1 revealed that IAA treatment cause significant increases in flag leaf area and Chlorophyll content (SPAD) values compared to control. The highest values of flag leaf area value were obtained from plants treated with IAA at 150 ppm (46.12 cm²) and Chlorophyll content (SPAD) values from plant treated with IAA at 100 ppm. The application of IAA at growth stage S₂ (Booting) showed maximum flag leaf area and Chlorophyll content (SPAD) values of concerning. The interaction effect, the maximum values of flag leaf area were recorded with spraying of 150 ppm of IAA treatment and S₂ (Booting). In contrast, the lowest values of flag leaf area were obtained by control. These results may be attributed to the role of IAA in enhancement of growth and development of plants by stimulating wide range of processes, including cell division and tissue growth, phototropism and gravitropism, apical dominance, lateral root initiation, differentiation of vascular tissues, embryogenesis, senescence and ripening [10]. In addition, increasing cell elongation and accumulation of building units accompanied by greater saccharides content [8].

The data given in Table 1 the effect of various IAA concentration, differed significantly in spike length (cm). It revealed that treatment 100 ppm shows maximum spike length (14.25 cm), also revealed that various growth stage on spike length it was observed that various growth stage significantly affected spike length. The spike length of (13.11 cm) were recorded in the S₂ (Booting). The interaction of wheat growth stage and and IAA concentration was also highly significant of study. The treatment S₂ (Booting) ×100 ppm IAA produced maximum spike length (14.96 cm), while the lowest spike length (10.10 cm) were recorder in treatment 0 ppm IAA with S₁ (Tillering stage).
Table 1: Plant height (cm), Leaf area flag (cm), Chlorophyll contents (SPAD), Spike length (cm) as affected by foliar IAA at three growth stages of transplanted wheat.

| Treatments | Plant height (cm) | Flag leaf area (cm²) | Chlorophyll content (SPAD) | Spike length (cm) |
|------------|-------------------|----------------------|---------------------------|-------------------|
| IAA(ppm)   |                   |                      |                           |                   |
| 0          | 79.99             | 37.78                | 38.96                     | 10.34             |
| 50         | 85.84             | 44.46                | 47.20                     | 12.81             |
| 100        | 92.36             | 45.79                | 51.04                     | 14.25             |
| 150        | 92.10             | 46.12                | 50.22                     | 13.81             |
| LSD(0.05)  | 4.65              | 2.26                 | 2.84                      | 0.97              |

Growth stage

|                | Plant height (cm) | Flag leaf area (cm²) | Chlorophyll content (SPAD) | Spike length (cm) |
|----------------|-------------------|----------------------|---------------------------|-------------------|
| S₁             | 88.96             | 42.64                | 47.58                     | 12.34             |
| S₂             | 88.81             | 44.11                | 48.01                     | 13.11             |
| S₃             | 84.95             | 43.85                | 44.98                     | 12.95             |
| LSD(0.05)      | 1.56              | 1.80                 | 2.14                      | 0.43              |
| 0x S₁          | 79.10             | 37.15                | 40.01                     | 10.10             |
| 0x S₂          | 81.77             | 37.49                | 37.10                     | 10.66             |
| 0x S₃          | 79.10             | 38.70                | 39.78                     | 10.26             |
| 50x S₁         | 86.57             | 43.07                | 47.90                     | 12.33             |
| 50x S₂         | 88.87             | 45.00                | 48.68                     | 12.66             |
| 50x S₃         | 82.10             | 45.30                | 45.01                     | 13.43             |
| 100x S₁        | 95.93             | 44.02                | 50.89                     | 13.60             |
| 100x S₂        | 91.30             | 47.56                | 54.66                     | 14.96             |
| 100x S₃        | 89.83             | 45.79                | 47.55                     | 14.20             |
| 150x S₁        | 94.23             | 46.34                | 51.50                     | 13.33             |
| 150x S₂        | 93.30             | 46.39                | 51.59                     | 14.16             |
| 150x S₃        | 88.77             | 45.62                | 47.56                     | 13.93             |
| LSD(0.05)      | 4.94              | 3.46                 | 4.19                      | 1.11              |

3.2. Yield and its components in wheat

The results showing table 2 revealed that plant growth regulator (IAA) application in relation to wheat growth stages, affected significantly the number of spikes m⁻². The data on number of spikes (m⁻²) indicated that various IAA concentration of wheat different significantly. It revealed that the 100 ppm (IAA) produced maximum number of (365.3) spikes m⁻². The effect of growth stage on number of spikes were found significant. The growth stage S₂(Booting stage) of growth stage followed by S₃ (flowering stage). The interaction of IAA concentration and wheat growth stage was also highly significant of experiment. The plant growth regulator (IAA) 100 ppm × S₃ (Flowering stage) gave maximum number of (380.7) spike m⁻². While the lowest number of spikes m⁻² were recorded in plots with control 0 ppm (IAA) at S₁.

Table 2 shows that number of grain /spike were significantly elevated after spraying with either the indol-3-acetic acid 150 ppm which highest values of number of grain/spike (53.42g) . However, number of grain/spike were significantly in creased following spraying with IAA together. The results shown revealed that wheat growth stage non affected significantly the number of grain/spike . The interaction of IAA concentration and growth stage wase significant. The treatment 150 ppm × S₂(Booting stage) showed more normal grain of (53.10) grain /spike. These results of IAA treatments are in agreement with those obtained by [4],[5].

Data in table 2 indicated that 1000- grain weight (g) was significant at different IAA concentration of experimentation in response of wheat growth stage . Highest 1000-grain weight of (36.50g) at IAA concentration 100 ppm while the lowest 1000-grain weight was noted in the control. Growth stage affected the 1000-grain weight .The highest 1000-grain weight was recorded in S₂ (Booting stage)
producing (35.92) g.

The results of this study showed significant main effects of IAA concentration and growth stage on grain yield (Table 2) significant increases in the studied grain yield with increasing IAA concentration from 0 up to 100 ppm are shown in table 2. Application of 100 ppm IAA led to production of maximum grain yield 6.61 t/ha⁻¹. This result is because the dominance of 100 ppm treatment in number of spike and 1000-grain weight. Table 2 shows that grain yield was significantly affected for different growth stage of wheat. The crop growth stage S₂ (Booting stage) showed economical grain yield of 6.43 t/ha⁻¹, while the lowest grain yield of 5.84 t/ha⁻¹ was recorded in the growth stage S₁ (Tillering stage). The results show that there were significant interaction between IAA and growth stage on grain yield, the highest values were obtained from spraying of 150 ppm IAA integrated with S₂ (Booting stage). The lowest values were recorded from spraying of water treatment with S₂ (Booting stage).

Data are shown in table 2 indicated that biological yield were significantly affected with IAA concentration application. The highest IAA application 150 ppm produced the highest biological yield 15.73 t/ha⁻¹, however differences between 100 and 150 ppm did not reach the significance. As far as the effect of growth stage on biological yield, it was observed that various growth stage significantly affected the biological yield, at growth stage S₂ (Booting stage) showed maximum biological yield of 15.68 t/ha⁻¹. The interaction of growth stage and IAA was also significant of study at the treatment 100 ppm and S₂ (Booting stage) was at top with 16.13 t.ha⁻¹ biological yield.

Table (2) Number of spikes / m², Number of grain/spike, 1000-grain weight (g), Grain yield (t/ha), Biological yield (t/ha) as affected by foliar IAA at three growth stages of transplanted wheat.

| Treatments IAA (ppm) | Number of spikes / m² | Number of grain/spike | 1000-grain weight (g) | Grain yield (t/ha) | Biological yield (t/ha) |
|----------------------|-----------------------|-----------------------|-----------------------|--------------------|-------------------------|
| 0                    | 335.4                 | 45.80                 | 34.58                 | 5.55               | 14.52                   |
| 50                   | 343.1                 | 52.62                 | 35.39                 | 6.22               | 15.14                   |
| 100                  | 365.3                 | 52.16                 | 36.50                 | 6.61               | 15.61                   |
| 150                  | 351.1                 | 53.42                 | 35.60                 | 6.33               | 15.73                   |
| LSD(0.05)            | 14.9                  | 1.09                  | 0.86                  | 0.38               | 0.29                    |

| Growth stage S₁      | 338.4                 | 50.82                 | 35.12                 | 5.84               | 14.96                   |
| S₂                   | 356.8                 | 51.10                 | 35.92                 | 6.43               | 15.68                   |
| S₃                   | 351.1                 | 51.08                 | 35.53                 | 6.25               | 15.11                   |
| LSD(0.05)            | 11.7                  | 1.40                  | 0.61                  | 0.33               | 0.34                    |
| 0x S₁                | 337.7                 | 46.10                 | 34.63                 | 5.57               | 14.53                   |
| 0x S₂                | 342.3                 | 45.97                 | 34.32                 | 5.49               | 14.68                   |
| 0x S₃                | 326.3                 | 45.33                 | 34.81                 | 5.58               | 14.36                   |
| 50x S₁               | 329.3                 | 53.00                 | 34.66                 | 5.90               | 14.62                   |
| 50x S₂               | 366.3                 | 52.27                 | 35.78                 | 6.10               | 15.80                   |
| 50x S₃               | 333.7                 | 52.60                 | 35.74                 | 6.65               | 15.00                   |
| 100x S₁              | 342.7                 | 50.63                 | 35.83                 | 6.24               | 14.96                   |
| 100x S₂              | 372.7                 | 52.53                 | 37.79                 | 7.02               | 16.13                   |
| 100x S₃              | 380.7                 | 53.30                 | 35.88                 | 6.59               | 15.75                   |
| 150x S₁              | 344.0                 | 53.53                 | 35.34                 | 5.66               | 15.74                   |
| 150x S₂              | 345.7                 | 53.63                 | 35.78                 | 7.12               | 16.10                   |
| 150x S₃              | 363.7                 | 53.10                 | 35.68                 | 6.20               | 15.34                   |
| LSD(0.05)            | 22.7                  | 2.44                  | 1.22                  | 0.62               | 0.60                    |

4. Conclusion:

From the present experiment, it can be concluded that various levels of plant growth regulator (IAA)
significantly affected the various growth stages of transplanted coarse wheat. The application of IAA concentration of 100 ppm at booting stage had significant beneficial effects on the yield attributes and increased the grain yield of wheat.

5. References

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