Assiut J. Agric. Sci., (50) No. (1) 2019 (107-124) *ISSN: 1110-0486*
Website: www.aun.edu.eg/faculty_agriculture/journals_issues_form.php *E-mail: ajas@aun.edu.eg*

Growth and Yield of Some Jew's Mallow (*Corchorus olitorius* L.) Ecotypes as Affected by Planting Dates and Foliar Application of Gibberellic and Humic Acids

Haridy, A.G.; H.S. Abbas and A.A. Mousa

Department of Vegetables, Faculty of Agriculture, Assiut University, Assiut, Egypt
*E-mail: ashrafharidy@aun.edu.eg

Received on: 15/1/2019 **Accepted for publication on:** 21/1/2019

Abstract:

A Field experiment was conducted in 2015 and 2016 cropping seasons at the Vegetable Crops Research Station, Faculty of Agriculture, Assiut University, to study the response of three Jew's Mallow Ecotypess (Assiut, Eskandarany and Aswan) to planting dates and foliar application of Gibberellic acid (GA3) and Humic acids (HA) treatments. The Jew's Mallow ecotypes were planted on 15th Feb. and 15th Oct. in both cropping seasons and subjected to three foliar applications of 0.25mg.l^{-1} GA_3 (T1), 0.5mg.l^{-1} HA (T2) and 0.5mg.l^{-1} HA + 0.25mg.l^{-1} GA_3 (T3) and untreated plants were used as control. The results revealed that the Jew's Mallow ecotype 'Assiut' attained the highest plant (cm), number of leaves/plant, weight of leaves/plant(g), weight of plant (g), percentage net weight of leaves/plant and foliage yield (kg.plot^{-1}) in both seasons. The early planting date (15 Feb.) extremely increased growth, yield components and yield parameters in 2015 and 2016. Foliar application of gibberellic acid (GA_3) at 0.25mgl^{-1} (T1) significantly increased growth and yield of Jew's Mallow plants. Spraying plants of the Jew's Mallow ecotype 'Assiut' with GA_3 at 0.25 mg.l^{-1} at planting date 15th Feb. significantly increased growth, yield components and yield parameters in both seasons.

Keywords: *Jew's Mallow, GA3, Humic acid, planting dates, foliar spraying, Ecotypess.*

Introduction

Jew's Mallow (*Corchorus olitorius* L.), sometimes known as Jute Mallow, is one of the most important leafy vegetable in tropical areas including Egypt. Egypt cultivated about 887 ha jew's mallow and produced about 2173 tons with a productivity of 2.4499 ton/ha (FAO, 2016). Jew's mallow is considered as one of the most important vegetables bringing daily cash for smallholders and poor families in Egypt particularly Upper Egypt. However, less attention was paid by researches to conduct studies for improving the crop growth, yield, quality and nutritional values. Recently, Jew's Mallow as a Neglected and Underutilized crop Species (NUS) received great international recognition because of its role in providing food and nutrition security and income opportunities among smallholder farmers. Also, the NUS crops can be utilized to adapt agriculture and food systems to climate change. Egyptian farmers with particular to Upper Egypt farmers (smallholders) grew Jew's Mallow in many marginal areas for their livelihoods. They use their own seeds which consequently result in genetic erosion and low yield and quality due to low fertility soil, add no fertilizers, pest and diseases (Abdallah *et al.,* 2010; Rashwan, 2011). Cultivating Jew's Mal-

low in marginal areas without adding either any fertilizers/small amounts to the soil (organic and/or inorganic fertilizers) or to the plants (foliar application of fertilizers) caused great reduction in crop yield and quality (Ogunrindé and Fasinmirin, 2011). Suitable planting dates of vegetables increases growth and yield without adding extra production costs. Jew's mallow is a short-day plant and grows well at high humidity and a temperature range 25 - 35°C (Vincent and Yamaguchi, 1997). Low temperature and short day promote plant flowering at early growth stage and reduce vegetative growth. In Egypt, It was reported that late planting dates (1st June) increased vegetative growth, yield components, yield and chemical constituents, while reduced the percentage of net leaves weight as compared with planting dates 1st of April and 1st of May. (Wahba *et al*., 2003; Abd-Allah and Nasr, 2005). Foliar application of fertilizers is a promised alternative source of fertilizers that expected to enhances crop yield and quality. Gibberellic acid (GA_3) is a phytohormone caused extremely acceleration for plant growth and development when applied at low concentrations. Plant Acceleration occurred when growth regulators like GA_3 exogenously applied in proper concentration at a proper time in a specific crop (Saini *et al*., 2017). GA_3 play significant roles in plant growth and development including enhances growth activities to plant (Saini *et al*., 2017), stimulates stem elongation (Lee, 1990), and increases dry weight and yield (Deotale *et al.,* 1998 and Maske *et al.,* 1998). Humic acid (HA) is a bio-fertilizer can be extracted from any materials containing well-decomposed organic matter like soil, coal, compost, etc. Manipulation and preparation of Humic acid can be simply conduct using a solution of sodium hydroxide which causes much dissolves of the organic matter. ph of the humic solution can be adjusted to 2 using acids. The organic material will begin to flocculate and can be separated from the liquid portion (Kussow, 2002). Humic material can be added to the soil as ground fertilizers to ameliorate soil constructing and ground microorganisms. Ghabbour and Davies, (2001) reported that adding humic material to the soil decreasing the unfavorable effects of chemical fertilizers on the ground and reign a major effect on plant growth. On the other hand, Humic materials can be successfully sprayed over the plants to elevate plant growth, yield and quality (Yildirim, 2011). There were a limited information about the effects of growth regulators like GA_3 and organic products like HA on growth, yield and quality of leafy vegetables with particular Jew's Mallow at different planting dates. The presented work aimed to study growth and yield response of three Jew's Mallow ecotypes to planting dates and application of Humic acid (HA) and gibberellic acid (GA_3).

Materials and Methods

Plant Materials

The genetic materials of jew's mallow were three ecotypess called 'Eskandarany', 'Balady Aswan' and 'Balady Assiut' (Obatined from Local Agricultural markets in Alexandria, Aswan and Assiut governorate, respectively.). Germination test was

conducted in the laboratory of vegetable crops to test seeds viability.

Experimental site and design

A Field experiment was conducted at the Vegetable Crops Research Station, Faculty of Agriculture, Assiut University, Egypt, during 2015 and 2016. Main soil physical and chemical proprieties were as follow: soil texture clay, pH 8, field capacity 42%, available phosphorus 0.01% and total nitrogen 0.08%. The experiment was laid out in split plot following in randomized complete block design (RCBD) with 3 replicates. The Jew's mallow ecotypes were in the main plots, while GA_3 and HA treatments were in the sub plots.

Soil preparation, planting and Agriculture Practices

The experimental site was plowed 3 perpendicular times 2 months before planting. Two weeks before planting the site was well leveled and divided into plots each of 3m x 3m. Seeds of jew's mallow cultivars were planted in 15th Feb. and 15th Oct. 2015 and 2016. Seeds of all jew's mallow ecotypes were planted in rows with planting space 20 cm between row and 10 cm between plants. Cultural practices (irrigation, fertilization and pests and diseases control) were applied as recommended for jew's mallow production (Abd-Allah, 2006).

Gibberellic (GA_3) and Humic acid (HA)Treatments.

The Humic acid (24%) and Gibberellic acid (35%) were used as plant stimulants to enhance plant growth and subsequently foliage yield. The following treatments of Humic and Gebrillic acids were foliar sprayed after 30 days from sowing:

1. Control: plants received niether HA nor GA_3 treatments
2. HA: foliar application of HA at 0.5mg.l^{-1}
3. GA_3: foliar application of GA_3 at 0.25mg.l^{-1}
4. HA+GA_3: foliar application of Humic acid and GA_3 combination at 0.5mg.l^{-1} (HA) and 0.25mg.l^{-1} GA_3.

Measurments

The following parameters were measured using 20 randomly taken plants per/plot: plant height (cm), plant weight (g), number of leaves/ plant, leaves weight (g), percentage net weight of fresh leaves per plant = leaves weight per plant (g) / plant weight (g) x 100 and total foliage yield per plot was recorded in kg per plot as the total weight of plants in each plot.

Statistical procedures:

The data were subjected to combined analysis over year using model analysis (Gomez and Gomez, 1984). Before combining the data single analysis of variance for each year was conducted to test normal distribution of the data and variances homogeneity (Gomez and Gomez, 1984). Analysis of variance was conducted using the Statistical Analysis System (SAS) program (ver. 9.00, SAS Institute, Cary, NC, USA). The treatment means were compared by F test and using Duncan"s New multiple range test (Steel and Torrie 1982).

Results and Discussion

There were significant differences due to planting dates, Jew's Mallow ecotypes, Humic (HA) and Gibberellic (GA_3) acids and their interaction for all measured parameters.

Plant height (cm)

Plant height of tested Jew's Mallow ecotypes were significantly affected by planting dates and foliar spray treatments (Table 1). The tallest plant were measured for plants of the ecotypes 'Assiut' with lengths 79.18 cm (15th Feb. 2105), 73.98 cm (15th Oct 2015), 81.67 cm (15th Feb. 2016) and 75.33 cm (15th Oct 2016). The shortest plants were produced by 'Eskandarany' in both planting dates in 2015 and 2016 (Table 1). Regarding effects of foliar application of GA_3 and HA, the results revealed that foliar application of GA_3 at 0.25mg l^{-1} increased plant height by 39.63% (15th Feb 2015), 54.62% (15th Oct. 2015), 63.66% (15th Feb 2016) and 49.41% (15th Oct 2016) as compared to the control (untreated plots). Regardless planting dates and ecotypes, the least plant height was observed for the untreated plots (control treatment). Planting the Jew's Mallow on 15th Feb significantly increased plant height in 2015 and 2016 (Table 1). Concerning interaction, spraying Jew's Mallow ecotypes 'Assiut' with GA_3 at 0.25mg l^{-1} result the longest plant with 90.55cm and 92.67cm for planting dates 15th Feb 2015 and 2016, respectively. The control treatment of ecotypes 'Aswan' produced the shortest plants with the late planting date 15th Oct in 2015 and 2016 (Table 1). Gibberellic acid (GA_3) as a phytohormone accelerate plant growth and development when it exogenously applied at low concentrations (Saini *et al.,* 2017). Time of application, method of application and GA_3 concentrations critically controls the roles and motivations of GA_3 in plant growth and development. For instance, application of GA_3 at proper concentration and time was reported to stimulate stem elongation (Lee, 1990), and increases dry weight and yield (Deotale *et al.,* 1998 and Maske *et al*., 1998). There were limited information and researches considered the effects of GA_3 and Humic acid (HA) on growth and developed of Jew's Mallow. However, in Indian mustard, Sani *et al*., (2017) reported that foliar application of GA_3 at 125 ppm resulted in maximum plant height (190.44 cm) at maturity stage, followed by foliar sprayed of GA_3 at 90ppm (188.33 cm) over control (180.55 cm). Spraying GA_3 significantly increased plant height of mungbeen at 40 days after sowing (38.57 cm) and 50 days after sowing (45.65 cm) as compared with biofertilizers and control treatments (Lee *et al.,* 1990). Moreover, the authoers found that GA_3 significantly increased plant height of the mungbeen variety 'Barimoog-2' at 40 days after sowing (40.53 cm) and 50 days after sowing (47.27 cm). Foliar application of Humic acid (HA) affected plant height of canola and maximum heights were obtained using HA at concentration of 2%, while shortest plants were observed under control treatments (Sani, 2014). Humic acid also significantly increased plant height of mustard (Rajpar *et al*., 2012), tomato and cucumber (Atiyeh *et al.,* 2002) and peppers (Arancon *et al*., 2006).

Weight of plant (g)

The results showed that, the early planting date (15th Feb.) extremely increased plant weights of all tested ecotypes as compared to late planting date (15th Oct.) in 2015 and

2016. Plants of the Jew's Mallow ecotypes 'Assiut' recorded the highest weight in both planting dates as compared with other tested ecotypes. However, the early planting (15th Feb) of ecotypes 'Assiut' extremely increased plants weight in 2015 and 2016 (Table 2). The maximum plant weights of ecotypes 'Assiut' were 76.59g (15th Feb 2015), 74.34g (15th Feb 2016), 68.93g (15th Oct 2015) and 71.54g (15th Oct 2016) Contrary, the least plant weight was observed for ecotypes 'Aswan' in late planting (15th Oct) in both seasons. Regarding effects of GA_3 and HA foliar spraying on plant weight of Jew's Mallow ecotypes, the results illustrated that spraying GA_3 at 0.25mg.l^{-1} significantly increased plants weight in late (15th Oct) and early planting (15th Feb) in 2015 and 2016. In addition HA in combination with GA_3 (0.5 mg.l^{-1} HA + 0.25 mg.l^{-1} GA_3) in early planting (15th Feb.) increased weight of Jew's Mallow plants (Table 2). The control treatment (without GA_3 and HA applications) produced the least plants weight (g) in late and early planting dates in both seasons. A significant interaction was observed between Jew's Mallow ecotypes, planting dates and foliar application of GA_3 and HA with regard weight of plant (g). Spraying plants of ecotypes 'Assiut' with GA_3 at 0.25mg^{-1} at early planting date (15th Feb) in 2015 result the highest weight of plants (95.37g), followed by application GA_3 at 0.25mg^{-1} at early planting date (15th Feb) of ecotypes Assiut' in 2016 with 93.35g and spraying ecotypes 'Assiut' with a combination of GA_3 at 0.25mg.l^{-1} + HA at 0.5 mg.l^{-1} at early planting date (15th Feb) in 2016 (Table 2). Oppositely, the least weight of plant (g) was observed at late planting (15th Oct) of ecotypes 'Eskandarany' in 2015 and 2016. There were limited information and researches considered the effects of GA_3 and Humic acid (HA) on growth and developed of Jew's Mallow. However, Indian mustered growth and yield was significantly affected by GA_3 application (Sani *et al.,* 2017). They reported that all GA_3 treatments significantly increased plant dry biomass as compared to the control treatment. Foliar application of GA_3 enhanced growth and yield of Cabbage (Akand, *et al.*, 2015); Tomato (Kumar *et al.*, 2014), strawberry (Jamal *et al.*, 2012) and indian mustard (Sani *et al.,* 2017). Moreover, humic acid significantly affected growth and yield of varied number of crops including Canola (Sani, 2014); Tomato (Abdellatif et al., 2017); Garlic (Abdel Razzak and El-SHarkawy, 2013). On the other hand, Jew's mallow is a short-day plant and grows well at high humidity and a temperature range 25 - 35°C (Vincent and Yamaguchi, 1997). Low temperature and short day promote plant flowering at early growth stage and reduce vegetative growth. In Egypt, It was reported that late planting dates (1st June) increased vegetative growth, yield components, yield and chemical constituents, while reduced the percentage of net leaves weight as compared with planting dates 1st of April and 1st of May. (Wahba *et al*. 2003; Abd-Allah and Nasr 2005).

Number of leaves/plant

Planting Jew's Mallow at 15th Feb in both seasons result the highest number of leaves/plant as compared

to planting date 15th Oct. The ecotypes 'Assiut' produced the maximum number of leaves/plant in 2015 and 2016, followed by the ecotypes 'Eskandarany', while the ecotypes 'Aswan' produced the least number of leaves/plan. Spraying GA_3 at 0.25mg.l^{-1} significantly increased number of leaves/plant, while the control treatment (without application of GA_3 and HA) revealed the least number of leaves/plant (Table 3). Regarding interaction the results illustrated that spraying plants of the ecotypes 'Assiut' at early planting date (15th Feb 2015) by GA_3 at 0.25mg.l^{-1} result the highest number of leaves per plant (70.08). As presented in Table (3), the least no. of leaves/plant was observed for plants of ecotypess 'Aswan' (22.40) and 'Eskandarany' (22.70) under late planting (15th Oct 2016) and without application of GA_3 and HA (control treatment). Tsiakaras *et al*. (2014) investigated the effects of nitrogen application rate and gibberellic acid (GA_3) on yield and earliness of production and marketability of lettuce. They observed that GA_3 and high nitrogen rates significantly increased total number of leaves per plant. Application of GA_3 at 75 ppm result in the highest no. of leaves/plant (21.04 leaf/plant), while the minimum no. of leaves/plant (7.13) was noted at control treatment (Roy and nasiruddin, 2011). Number of leaves per plant varied significantly at different days after transplanting (DAT) due to application of different concentrations of GA_3. The maximum leaves per plant (15.05) was observed in GA_3 (90 ppm) and the minimum (11.47) was found from GA_3 (0.0 ppm) at 60 days after sowing (Kairul Mazed, 2015). In Egypt, it was reported that late planting of Jew's Mallow (1st June) significantly reduced percentage of net weight of plant leaves due to high temperature and day length (Wahba et al. 2003; Abd-Allah and Nasr 2005). In addition, Rashwan (2011) found that planting Jew's Mallow ecotypess on April 25th result the highest plant heights, foliar yield and fresh and dry mass of plants. In Egypt highest fresh leafy yield of Jew's Mallow ecotypess was obtained with planting dates mid May and mid April (Abd-Allah *et al*., 2010).

Weight of leaves/plant (g)

The sowing dates 15th Feb in 2015 and 2016 revealed the highest weight of leaves/plant as compared to the planting dates 15th Oct. in both seasons. The Jew's Mallow ecotypes were significantly varied with regard weight of leaves/plant (g). The ecotypes 'Assiut' produced the highest weight of leaves/plant with 32.45, 34.65, 25.59 and 24.28 (g) for planting dates 15th Feb. 2015, 15th Feb. 2016, 15th Oct. 2015 and 15th Oct. 2016, respectively (Table 3). Foliar application of GA_3 at 0.25mg.l^{-1} result highest weight of leaves/plant in both seasons, followed by combination of GA_3 at 0.25mg.l^{-1} + HA at 0.5 mg.l-1, while control treatment (without foliar application of GA_3 and HA) recorded the least weight of leaves/plan. A significant interaction was observed between planting dates, Jew's Mallow ecotypes and foliar spray treatments. Sowing the ecotypes 'Assiut' on 15th Feb. in 2015 and 2016 and spraying the plants with GA_3 at 0.25mg.l^{-1} result the highest weight of leaves/plant (45.86 and

50.00 (g) for sowing dates 15th Feb. in 2015 and 2016, respectively, Table 3). The control treatment (without spraying GA_3 and HA) recorded the least weigh of leaves/plant for the ecotypess 'Eskandarany' and 'Aswan' on planting dates 15th Oct. 2015 and 2016. Tovihoudji *et al*., (2015) evaluated the application of municipal solid waste compost (MSWC), cow dung (CD) and Urea (46%, kg.ha-1) on weight of fresh and dry leaves of Jew's Mallow. They found that applying MSWC at 20 $t.ha^{-1}$ recorded the highest weight of fresh leaves (33.3 $g.plant^{-1}$) followed by MSWC at 30 $t/.ha^{-1}$ (26.5 $g.plant^{-1}$), CD 30 at $t.ha^{-1}$ (21.5 $g.plant^{-1}$) and urea at100 $kg.ha^{-1}$ (21.5 $g.plant^{-1}$). In lettuce it was reported that GA_3 significantly influenced the fresh weight of leaves per plant at 25, 35 and 45 days after planting (Akter, 2015). The author observed that the maximum weight of fresh leaves $g.plant^{-1}$ (30.35, 89.61 and 181.55 g at 25, 35 and 45 DAS respectively) was recorded with application of GA_3 at 20ppm. Moreover, he observed that weight of fresh leaves $g.plant^{-1}$ (17.74, 45.84 and 101.7 g at 25, 35 and 45 DAS respectively) was recorded with control treatment. Sani (2104) reviewed that humic acid applications have positive effects on dry matter productivity and on nutrient mechanism of lettuce plant.

Percentage net weight of leaves/ plant

Percentages of net weight of plant leaves were significantly affected by sowing dates, ecotypess, foliar application and their interactions. Sowing Jew's Mallow plants on 15th Feb. in 2015 and 2016 significantly increased percentages of net weight of plant leaves/ plant as compared to late planting dates. The ecotypes 'Assiut' revealed highest percentages of net weight of leaves/plant in both seasons, followed by the ecotypes 'Eskandarany', while ecotypes 'Aswan' registered the least percentages of net weight of leaves/plant (Table 5). The Application of GA_3 at $0.25mg.l^{-1}$ significantly increased percentage net weight of plant leaves in both seasons, followed by $0.5mg.l^{-1}$ HA + $0.25mg.l^{-1}$ GA_3 and HA at 0.5mg.l-1, whereas the control treatment revealed the least percentages of net weight of plant leaves in 2016. Significant interaction was observed between sowing dates, Jew's Mallow ecotypes and application of GA3 and HA with regard percentage net weight of plant leaves. Foliar application of GA3 at $0.25mg.l^{-1}$ extremely increased the percentages of net weight of plant leaves of the ecotypes 'Assiut' at the planting dates 15th Feb. 2015 (50.56%) and 15th Feb. 2016 (51.45%). Contrary, the ecotypes 'Aswan' recorded the least percentages of net weight of plant leaves under effects of foliar application of HA at $0.5mg.l^{-1}$ at late planting dates in both season (Table 5). The reasons for these observations can be attributed to the small number of leaves/plant, low weight of leaves/plant and partially elevated weight of plant produced by 'Aswan' ecotypes under foliar application of HA at $0.5mg.l^{-1}$. Contrary, adaptability of the ecotypes 'Assiut' to local climate increase effectiveness of foliar application of GA3 which result maximum number of leaves/plant, weight of leaves/plant,

weight of plant and subsequently percentage of net weight of plant leaves. Yield of fresh weight of Jew's Mallow was significantly increased by foliar application of GA_3 at 20 ppm (Akter, 2015). In addition, it was reported that foliar application of humic acid significantly enhanced weight of leaves and weight of plant of lettuce (Sani, 2014). The Jew's Mallow ecotypes 'Mansoura' was reported to produce the maximum percentage of net weight of leaves/plant when cultivated in mid May as compared with other tested ecotypess and planting dates (Abdallah *et al*., 2010). The obtained results were partially in line with that observed by Wahba *et al*., (2003); Abd-Allah and Nasr (2005) and Rashwan (2011). They reported that late planting of Jew's Mallow (1st June) significantly reduced percentage of net weight of plant leaves due to high temperature and day length (Wahba *et al*., 2003; Abd-Allah and Nasr 2005). Planting Jew's Mallow ecotypess on April 25th result the highest plant heights, foliar yield and fresh and dry mass of plants (Rashwan (2011). It was recommended that mid May and Mid April are the promising planting dates for highest fresh leafy yield of Jew's Mallow ecotypess in Egypt (Abd-Allah *et al*. 2010).

Foliage Yield (kg.plot^{-1})

As presented in Table (6), the early planting dates 15th Feb. 2015 and 2016 result the highest foliage yield (kg.plot^{-1}), whereas sowing dates 15th Oct. significantly reduced the foliage yield in both seasons. Regarding the Jew's Mallow ecotypess, the results illustrated that ecotypes 'Assiut' produced the highest foliage yield since its extreme adaptability to the local dominant climate of the experimental location. The total foliage yield of ecotypes 'Assiut' were 19.89 and 17.45 kg.plot^{-1} for planting dates 15th Feb. 2015, 15th Feb. 2016 respectively and 15.96, 14.74, kg.plot^{-1} for planting dates 15th Oct. 2015, 15th Oct. 2016, respectively (Table 6). Least foliage yield were recorded for the ecotypes 'Aswan' at all planting dates. Concerning foliar applications the results revealed that spraying GA_3 at 0.25mg.l^{-1} extremely increased total foliage yield of Jew's Mallow in both seasons, while the control treatment (without application of GA_3 and HA) significantly reduced the total foliage yield (Table 6). Regarding interaction, the results showed that spraying plants of the ecotypes 'Assiut' with GA_3 at 0.25mg.l^{-1} at planting dates 15th Feb. result significant increase in foliage yield (kg.plot^{-1}) in both seasons (28.35 and 26.26 kg.plot^{-1} in 15th Feb. 2015 and 2016, respectively). The ecotypes 'Aswan' recorded the least foliage yield under late planting conditions (15th Oct.) and control treatment (without application of GA_3 and HA) in both seasons (10.07 and 8.03 kg.plot^{-1} in 15th Oct. 2015 and 15th Oct. 2016, respectively). Total yield of Jew's Mallow as all leafy vegetable dependent on yield attributes including number of leaves/plant, weight of plant leaves and percentage net weight of plant leaves (the ratio of weight of leaves: weight of plant). The Jew's Mallow ecotypes 'Assiut' is commonly known and continuously cultivated by farmers in Assiut regions several years ago. Its high growth and yield performance reflecting its consistent

adaptability to dominant climates of Assiut regions. Based on this phenomenon the ecotypes 'Assiut' recorded highest values of yield attributes and subsequently total foliage yield (highest foliage yield ($kg.plot^{-1}$). The obtained results were partially in line with that observed by Wahba *et al.,* (2003); Abd-Allah and Nasr (2005) and Rashwan (2011). They reported that late planting of Jew's Mallow (1st June) significantly reduced percentage of net weight of plant leaves due to high temperature and day length (Wahba *et al.* 2003; Abd-Allah and Nasr 2005). Planting Jew's Mallow ecotypess on April 25th result the highest plant heights, foliar yield and fresh and dry mass of plants (Rashwan (2011). It was recommended that mid May and Mid April are the promising planting dates for highest fresh leafy yield of Jew's Mallow ecotypess in Egypt (Abd-Allah *et al.,* 2010).

GA_3 and Humic acid play significant roles in plant growth and development including enhances growth activities to plant (Saini *et al.,* 2017), stimulates stem elongation (Lee, 1990), and increases dry weight and yield (Deotale *et al.,* 1998 and Maske *et al.,* 1998). Limited information are available about the roles of GA_3 and HA to enhance growth and yield of Jew's Mallow. In Indian mustard Sani *et al*., (2017) reported yield and quality contributing traits were maximum recorded with foliar sprayed of GA_3 at 125 ppm followed by foliar sprayed with GA_3 at 90ppm over rest of the treatments including control. Fresh leaves yield of Jew's Mallow was significantly increased by foliar application of GA_3 at 20 ppm (Akter, 2015). Moreover, foliar application of humic acid significantly enhanced yield attributes and total fresh yield of lettuce as compared to control treatment (Sani, 2014).

Conclusion

Out of the present study, it is recommended to grow the ecotype Assiut on feb. 15th and use foliar spray with GA_3 at 0.25mg.l-1 to produce an enhanced growth, yield and yield components.

References

Abd- Allah, S.A.M. and Nasr M.A. (2010). Effect of Sowing Date and Preservation Methods on some Egyptian Moloukhyia Genotypes (*Corchorus olitorius*, L.). Minufiya J. Agric. Res. Vol . 3 1 No. 4: 981-995.

Abd-Allah, S.A.M. (2006). Variation and interrelationships of some Egyptian Moloukhyia genotypes (*Corchorus olitorius* L.). J. Agric. Sci. Mansoura Univ., 31(4): 2285 – 2296.

Abdellatif, I.M.Y., Abdel-Ati Y.Y., Abdel-Mageed Y.T., Mohamed and Hassan A.H. (2017). Effect of Humic Acid on Growth and Productivity of tomato plants under heat stress. Journal of Horticultural Research, 25(2): 59-66.

Abdel-Razzak, H.S. and El-Sharkawy G.A. (2013). Effect of biofertilizer and humic acid applications on growth, yield, quality and storability of two garlic (*Allium sativum* L.) Cultivars. Asian Journal of Crop Science, 5: 48-64.

Akand H.M.d., Khairul Mazed H.E.M., Pulok A.I., Moonmoon J.F. and Partho S.G. (2015). Influence of different dose of nitrogen on the growth and yield of cabbage (*Brassica oleracea* var. *capitata* l.). International Journal of Multid-

isciplinary Research and Development 2015; 2(2): 11-14 .

Akter, T. (2015). Effect of gibberllic acid and spacing on growth and yield of lettuce (*Lactuca sativa* L.). MSc., Department of Horticulture, Sher-E-Bangla Agriculture University, Dhaka1207.

Arancon NQ, Edwards CA, Lee S, Byrne R. (2006). Effects of humic acids from vermicomposts on plant growth. European Journal of Soil Biology; 42: S65–S69.

Atiyeh RM, Lee S, Edwards CA, Arancon NQ, Metzger JD. (2002). The influence of humic acids derived from earthworm-processed organic wastes on plant growth. Bioresource Technology; 84:7–14.

Deotale, R.D., Maske V.G., Sorte M.V., Chimurkar B.S. and Yeme A.Z. (1998). Effect of GA_3 and IAA on morpho-physiological parameters of soybean. J. Soils Crops, 8: 91-94.

FAO. (2009). Food and Agriculture Organization of the United Nations. Jute Production Statistic. (www.fao.org).

Ghabbour, E.A. and Davies G. (2001). Humic Substances: Structures, Models and Functions. Royal Society of Chemistry, England, ISBN: 9780854048113, pp. 387.

Gomez, K.A. and A.A. Gomez.(1984). Statistical procedures for agricultural research. 2nd ed. John Wiley and Sons, New York.

Jamal Uddin AFM, Mehraj H, Taufique T, Ona AF, Parvin S (2014). Foliar application of gibberelic acid on growth and flowering of gerbera cultivars. Journal of Bioscience and Agriculture Research, 2(1), 52-58.

Khairul Mazed, H.E.M., Hasanuzzaman Akand M.d., Israt J.I., Moonmoon J.F., Hafizur Rahman M.D. (2015). Effect of gibberellic acid on the growth and yield of cabbage (*Brassica oleracea* var. capitata L.). International Journal of Applied Research, 1(4): 24-29.

Kumar, A., Biswas, T.K., Singh, N. and Lal, E.P. (2014). Effect of gibberellic acid on growth, quality and yield of tomato (*Solanum lycopersicon* Mill.). OSR Journal of Agriculture and Veterinary Science (IOSR-JAVS), **7**: 28-30.

Kussow, W.R.(2002). Humate and Humic Acid. June 2002 web issue of Horticulture Update. http://aggiehorticulture.tamu.edu/extension/newsletters/hortupdate/jun02/art4jun.htmg> (October, 2007).

Lee, H.S. (1990). Effects of pre-sowing seed treatments with GA_3 and IAA on flowering and yield components in groundnuts. Korean J. Crop Sci., 35: 1-9.

Maske, B.G., Detale R.D., Sorte N.B., Goramnagar H.B. and Chore C.N. (1998). Influence of GA_3 and IAA on growth and yield contributing parameters of soybean. J. Soils Crops, 8: 20-21.

Netherlands/CTA, Wageningen, Netherlands. Harborne J.B., Baxter H., Moss G.P., (1999).

Ogunrinde A.T. and Fasinmirin J.T. (2011). Soil Moisture Distribution Pattern and Yield of Jute Mallow (Corchorus olitorius L.) under Three Different Soil Fertility Management. Proceedings of the Environmental Management Conference, Federal University of Agriculture, Abeokuta, Nigeria, 2011.

Rajpar1 I, Bhatti1 MB, Zia-ul-hassan1, Shah AN, Tunio SD. (2012). Humic acid improves growth, yield and oil content of *Brassica campestris* L. Pakistan Journal of Agriculture, Agricultural Engineering and Veterinary Sciences; 27:125-133.

Rashwan, A.M.A. (2011). Effect of sowing dates and plant spacing on growth and yield of some Jew's mallow ecotypess (*corchorus olitorius* L.) under South Valley condition. Assiut J. Agric. Sci., 42 No.2 (391-413).

Roy, R and Nasiruddin K. M. (2011). Effect of Different Level of GA_3 on Growth and Yield of Cabbage. J. Environ. Sci. & Natural Resources, 4(2): 79-82.

Sani, B. (2014). Foliar Application of Humic Acid on Plant Height in Canola. APCBEE Procedia (8): 82 – 86.

Saini, P.K., Yadav R.K. and Pratap M. (2017). Effect of Foliar Application of GA, on Yield and Quality of Indian Mustard [Brassica juncea (L.) Czern. & Coss.] Under Sodic Soil. Int. J. Curr. Microbiol. App. Sci (2017) 6(12): 4156-4159.

Steel, R.G.D. and Torrie, J.H. (1982). Principles and procedures of statistics. A biometrical approach. McGraw-hill Book Co., 625 pp.

Tovihoudji, G.P., Djogbenou P.D.C., Akponikpe P.BI, Kpadonou E., Agbanga C.E. and Dagbenonbakin D.G. (2015). Response of Jute Mallow (Corchorus olitorius L.) to organic manure and inorganic fertilizer on a ferruginous soil in North-eastern Benin. Journal of Applied Biosciences. 92:8610 – 8619.

Tsiakaras, G., Spyridon, A.P. and Khah, E.M. (2014). Effect of GA_3 and nitrogen on yield and marketability of lettuce (*Lactuca sativa* L.). Australian Journal of crop science, 8(1): 127-132.

Vincent, E.R. and M. Yamaguchi. (1997). World Vegetables: Principles, Production, and Nutritive Values. 2^{ed}., Department of Vegetables Crops. Uni. of California, Davis pp. 843. 849.

Yildirim EM. and Unay A. (2011). Effects of different fertilizations on Liriomyza trifolii in tomato. Afr. J. Agric. Res. 6(17): 4104-4107.

Wahba, R.M., S.M. Mansour, and E.A. Hassan. (2003). Vegetative yield and its components in Jew's mallow *(Corchorus olitorius,* L.) as affected by sowing date. J. Adv. Agric. Res. (8) 69-76.

Table 1. Means of Plant height (cm) of three Jew's Mallow ecotypes as affected by GA_3 and HA foliar application and planting dates during 2015 and 2016.

Jew's Mallow ecotypes	Foliar applications	Plant height (cm)			
		2015		2016	
		15th Oct	15th Feb	15th Oct	15th Feb
Eskandarany	Unteated (T0)	47.76ef	62.50ef	45.67i	48.46g
	0.25mg.l^{-1} GA_3 (T1)	70.03bcd	78.34cb	69.16de	74.56c
	0.5mg.l^{-1} HA (T2)	58.23de	67.17e	56.66fg	60.43e
	0.5mg.l^{-1} HA + 0.25mg.l^{-1} GA_3 (T3)	62.26cd	70.28de	60.40f	65.22dc
Assiut	Unteated (T0)	57.66efde	64.57e	51.76gh	58.56e
	0.25mg.l^{-1} GA_3 (T1)	83.03a	90.55a	86.76a	92.67a
	0.5mg.l^{-1} HA (T2)	74.86abc	80.16cb	74.33cd	80.18bc
	0.5mg.l^{-1} HA + 0.25mg.l^{-1} GA_3 (T3)	80.36ab	85.45ab	80.46b	86.45abc
Aswan	Unteated (T0)	43.46f	55.67f	49.37hi	56.46feg
	0.25mg.l^{-1} GA_3 (T1)	74.16abc	80.57cb	78.40bc	68.35dc
	0.5mg.l^{-1} HA (T2)	70.03bcd	78.46cb	67.06e	70.54dc
	0.5mg.l^{-1} HA + 0.25mg.l^{-1} GA_3 (T3)	62.70cd	78.54cb	68.60e	70.00dc
Mean Planting dates					
		65.38c	75.355a	65.72c	69.24b
Mean Jew's Mallow ecotypes					
Eskandarany		59.57b	66.82b	57.97b	49.56b
Assiut		73.98a	79.18a	75.33a	81.67a
Aswan		62.59b	68.25b	65.85ba	73.45a
Mean foliar applications					
Unteated (T0)		49.63c	56.17c	48.93d	50.45d
0.25mg.l^{-1} GA3 (T1)		76.74a	78.20a	73.11a	82.57a
0.5mg.l^{-1} HA (T2)		67.71b	71.24b	66.02c	63.23c
0.5mg.l^{-1} HA + 0.25mg.l^{-1} GA_3 (T3)		68.44ba	70.50b	69.82b	75.45b

Means with different letters within columns are significantly different at 0.05 level of the probability using "Duncan's multiple range test".

Table 2. Means of weight of plant (g) of three Jew's Mallow ecotypes as affected by GA_3 and HA foliar application and planting dates during 2015 and 2016.

Jew's Mallow ecotypes	Foliar applications	weight of plant (g)			
		2015		2016	
		15th Oct	15th Feb	15th Oct	15th Feb
Eskandarany	Unteated (T0)	47.26fg	54.23gh	43.67j	50.34h
	0.25mg.l^{-1} GA3 (T1)	71.46bcd	82.56bc	75.26cd	78.45cd
	0.5mg.l^{-1} HA (T2)	65.40de	72.45ef	60.33gh	66.46fg
	0.5mg.l^{-1} HA + 0.25mg.l^{-1} GA_3 (T3)	72.97bc	80.45bc	71.37def	76.23cde
Assiut	Unteated (T0)	51.13f	49.34h	57.03hi	60.59g
	0.25mg.l^{-1} GA_3 (T1)	81.52a	95.37a	88.06a	93.35a
	0.5mg.l^{-1} HA (T2)	67.26cde	71.65ef	60.00gh	74.05de
	0.5mg.l^{-1} HA + 0.25mg.l^{-1} GA_3 (T3)	75.83ab	87.34b	81.50bc	90.68a
Aswan	Unteated (T0)	44.63g	50.35gh	51.50i	57.48jg
	0.25mg.l^{-1} GA_3 (T1)	73.36bc	76.62de	67.00f	80.34bcd
	0.5mg.l^{-1} HA (T2)	61.57e	65.23f	66.83f	69.48ef
	0.5mg.l^{-1} HA + 0.25mg.l^{-1} GA_3 (T3)	64.57e	68.45f	68.00ef	70.45de
Mean Planting dates					
		64.75b	71.17a	65.88b	72.32a
Mean Jew's Mallow ecotypes					
Eskandarany		64.27b	70.02b	62.66b	69.56c
Assiut		68.93a	76.59a	71.54a	74.34a
Aswan		61.03c	67.17c	61.71b	66.25b
Mean foliar applications					
Unteated (T0)		47.67c	60.34c	51.07c	64.23d
0.25mg.l^{-1} GA3 (T1)		75.45a	79.36a	77.94a	85.46a
0.5mg.l^{-1} HA (T2)		64.74d	73.89b	63.05b	70.56c
0.5mg.l^{-1} HA + 0.25mg.l^{-1} GA_3 (T3)		71.12b	74.18b	73.95a	80.45b

Means with different letters within columns are significantly different at 0.05 level of the probability using "Duncan's multiple range test".

Table 3. Means of number of leaves/plants of three Jew's Mallow ecotypes as affected by GA_3 and HA foliar application and planting dates during 2015 and 2016.

Jew's Mallow ecotypes	Foliar applications	no. of leaves/plant			
		2015		2016	
		15th Oct	15th Feb	15th Oct	15th Feb
Eskandarany	Unteated (T0)	28.33fg	30.83g	22.70e	26.78e
	0.25mg.l^{-1} GA_3 (T1)	55.00abc	62.45b	51.00ab	57.34ab
	0.5mg.l^{-1} HA (T2)	47.70cd	51.44cd	39.70c	45.16cd
	0.5mg.l^{-1} HA + 0.25mg.l^{-1} GA_3 (T3)	50.34b	67.16ab	48.67ab	57.22b
Assiut	Unteated (T0)	32.00ef	40.34f	27.33de	37.12cd
	0.25mg.l^{-1} GA_3 (T1)	58.67a	70.08a	53.01a	62.00a
	0.5mg.l^{-1} HA (T2)	44.66d	48.22de	37.33c	45.34cd
	0.5mg.l^{-1} HA + 0.25mg.l^{-1} GA_3 (T3)	51.00b	61.50b	46.00b	54.23b
Aswan	Unteated (T0)	25.33g	33.76g	22.40e	32.14de
	0.25mg.l^{-1} GA_3 (T1)	37.33e	42.45ef	31.40d	45.30ab
	0.5mg.l^{-1} HA (T2)	34.70e	47.23de	23.67e	48.19cd
	0.5mg.l^{-1} HA + 0.25mg.l^{-1} GA_3 (T3)	34.33e	40.45f	26.33de	43.12cd
Mean Planting dates					
		41.62c	49.66a	35.79d	46.16b
Mean Jew's Mallow ecotypes					
Eskandarany		32.33b	45.33b	34.50b	51.34b
Assiut		46.58a	51.58a	40.91a	55.82a
Aswan		27.91c	32.91c	25.91c	47.34c
Mean foliar applications					
Unteated (T0)		28.55c	32.45d	24.11d	34.80d
0.25mg.l^{-1} GA_3 (T1)		50.33a	61.24a	45.11a	52.56
0.5mg.l^{-1} HA (T2)		42.33b	47.23cb	33.55c	50.06c
0.5mg.l^{-1} HA + 0.25mg.l^{-1} GA_3 (T3)		45.22b	51.45b	40.33b	56.45b

Means with different letters within columns are significantly different at 0.05 level of the probability using "Duncan's multiple range test".

Table 4. Means weight of plant leaves (g) of three Jew's Mallow ecotypes as affected by GA3 and HA foliar application and planting dates during 2015 and 2016.

Jew's Mallow ecotypes	Foliar applications	weight of leaves/plant (g)			
		2015		2016	
		15th Oct	15th Feb	15th Oct	15th Feb
Eskandarany	Unteated (T0)	14.00g	16.45h	10.60g	15.68
	0.25mg.l^{-1} GA_3 (T1)	24.10bc	32.67bc	23.27bc	29.34cb
	0.5mg.l^{-1} HA (T2)	18.90ef	23.54fg	15.27e	19.36f
	0.5mg.l^{-1} HA + 0.25mg.l^{-1} GA_3 (T3)	23.08cd	30.43cdh	21.27cd	28.49db
Assiut	Unteated (T0)	16.73fg	22.67g	13.89ef	19.68f
	0.25mg.l^{-1} GA_3 (T1)	34.70a	45.86a	38.22a	50.00a
	0.5mg.l^{-1} HA (T2)	23.27c	30.45cdh	19.35d	28.43db
	0.5mg.l^{-1} HA + 0.25mg.l^{-1} GA_3 (T3)	27.67b	34.23bc	25.67b	30.34b
Aswan	Unteated (T0)	13.97g	18.67h	11.78fg	20.68ef
	0.25mg.l^{-1} GA_3 (T1)	21.80cde	29.24dfh	20.02d	32.56b
	0.5mg.l^{-1} HA (T2)	17.56fg	23.34fg	11.59fg	19.86f
	0.5mg.l^{-1} HA + 0.25mg.l^{-1} GA_3 (T3)	19.33def	27.56ef	15.57e	22.46ef
Mean Planting dates					
		21.26c	27.92a	18.87d	26.40a
Mean Jew's Mallow ecotypes					
Eskandarany		20.02b	25.60b	17.60b	21.00b
Assiut		25.59a	32.45a	24.28a	34.65a
Aswan		18.17b	24.33b	14.74b	21.35b
Mean foliar applications					
Unteated (T0)		14.90d	19.34d	12.09d	18.59d
0.25mg.l^{-1} GA_3 (T1)		26.86a	35.00a	27.17a	40.33a
0.5mg.l^{-1} HA (T2)		19.91c	27.48c	15.40c	24.35c
0.5mg.l^{-1} HA + 0.25mg.l^{-1} GA_3 (T3)		23.36b	31.08b	20.84b	29.33b

Means with different letters within columns are significantly different at 0.05 level of the probability using "Duncan's multiple range test".

Table 5. Means of percentage net weight of plant leaves of three Jew's Mallow ecotypes as affected by GA3 and HA foliar application and planting dates during 2015 and 2016.

Jew's Mallow ecotypes	Foliar applications	% net weight of plant leaves			
		2015		2016	
		15th Oct	15th Feb	15th Oct	15th Feb
Eskandarany	Unteated (T0)	29.61De	34.45e	22.00efg	27.17g
	0.25mg.l-1 GA3 (T1)	33.74bc	40.36b	32.25b	37.13cbd
	0.5mg.l-1 HA (T2)	29.70de	37.18cd	25.45de	32.33edfg
	0.5mg.l-1 HA + 0.25mg.l-1 GA3 (T3)	31.56bcde	35.67de	30.73bc	40.55b
Assiut	Unteated (T0)	32.82bcd	36.78cde	27.64cd	33.18edfg
	0.25mg.l-1 GA3 (T1)	41.68a	50.56a	44.95a	51.45a
	0.5mg.l-1 HA (T2)	32.84bcd	39.05cd	30.25bc	36.28cbd
	0.5mg.l-1 HA + 0.25mg.l-1 GA3 (T3)	34.94b	40.23bc	31.52bc	35.67d
Aswan	Unteated (T0)	31.08bcde	40.19bc	20.94fg	32.26edfg
	0.25mg.l-1 GA3 (T1)	29.60de	34.23e	30.08bc	37.58cbd
	0.5mg.l-1 HA (T2)	28.31e	36.10cde	18.06g	28.90g
	0.5mg.l-1 HA + 0.25mg.l-1 GA3 (T3)	29.93cde	34.25e	25.22def	31.45fg
Mean Planting dates					
		32.15c	38.25a	28.25b	35.32a
Mean Jew's Mallow ecotypes					
Eskandarany		31.15b	37.56b	27.66b	35.45b
Assiut		35.57a	40.23a	33.59a	38.18a
Aswan		29.73b	36.58b	23.57c	30.87c
Mean foliar applications					
Unteated (T0)		31.17b	38.27b	23.59c	32.13d
0.25mg.l-1 GA3 (T1)		35.01a	41.12a	35.76a	41.29a
0.5mg.l-1 HA (T2)		30.28b	33.35c	24.59c	34.56c
0.5mg.l-1 HA + 0.25mg.l-1 GA3 (T3)		32.14b	36.40b	29.16b	35.78b

Means with different letters within columns are significantly different at 0.05 level of the probability using "Duncan's multiple range test".

Table 6. Means of foliage yield (kg.plot^{-1}) of three Jew's Mallow ecotypes as affected by GA3 and HA foliar application and planting dates during 2015 and 2016.

Jew's Mallow ecotypes	Foliar applications	Foliage Yield (kg/plot)			
		2015		2016	
		15th Oct	15th Feb	15th Oct	15th Feb
Eskandarany	Unteated (T0)	12.11c	17.34d	9.01de	14.91fg
	0.25mg.l^{-1} GA3 (T1)	16.16b	21.56b	15.76b	19.34bc
	0.5mg.l^{-1} HA (T2)	14.87b	19.27c	11.98cd	18.69bc
	0.5mg.l^{-1} HA + 0.25mg.l^{-1} GA3 (T3)	12.19c	17.76d	12.09cd	18.08c
Assiut	Unteated (T0)	11.83cd	19.32c	9.78de	15.45ef
	0.25mg.l^{-1} GA3 (T1)	19.06a	28.35a	21.24a	26.26a
	0.5mg.l^{-1} HA (T2)	13.24c	16.56edf	11.99cd	14.67fg
	0.5mg.l^{-1} HA + 0.25mg.l^{-1} GA3 (T3)	15.71b	19.23c	14.87bc	16.46de
Aswan	Unteated (T0)	10.07e	15.45gh	8.03e	12.39h
	0.25mg.l^{-1} GA3 (T1)	12.94c	16.23fg	12.11cd	15.55ef
	0.5mg.l^{-1} HA (T2)	11.85cd	15.37gh	8.23e	12.70gh
	0.5mg.l^{-1} HA + 0.25mg.l^{-1} GA3 (T3)	10.33de	14.56h	8.53e	13.24gh
Mean Planting dates					
		13.36b	18.41a	11.96c	16.47a
Mean Jew's Mallow ecotypes					
Eskandarany		13.83a	17.58b	12.21a	15.06b
Assiut		15.96a	19.89a	14.47a	17.45a
Aswan		11.30b	15.44c	9.24b	12.35c
Mean foliar applications					
Unteated (T0)		11.34c	13.67c	8.94c	12.45c
0.25mg.l^{-1} GA3 (T1)		16.05a	20.34a	16.37a	19.24a
0.5mg.l^{-1} HA (T2)		13.32b	17.58b	10.75cb	15.46b
0.5mg.l^{-1} HA + 0.25mg.l^{-1} GA3 (T3)		12.74b	16.90b	11.83b	15.34b

Means with different letters within columns are significantly different at 0.05 level of the probability using "Duncan's multiple range test".

Doi: 10.21608/ajas.2019.33488
Haridy et al., 2019 *http://ajas.journals.ekb.eg/*

نمو ومحصول بعض الطرز البيئية من الملوخية وتأثرهما بميعاد الزراعة والرش الورقي بحمضي الجبريلليك والهيوميك

أشرف جلال هريدي ، حسن سيد عباس وأحمد علي موسى

قسم الخضر–كلية الزراعة–جامعة أسيوط–أسيوط

المُلخص

أجريت هذه التجربة الحقلية بمزرعة الخضر البحثية – كلية الزراعة – جامعة أسيوط خلال مواسم ٢٠١٥ و ٢٠١٦ لدراسة أستجابة ثلاثة طرز بيئية من الملوخية وهي : أسيوط ، اسكندراني وأسوان لمواعيد الزراعة والرش الورقي بحامض الجبريلليك (GA_3) وحامض الهيوميك (HA).

زرعت الطرز البيئية الثلاثة في ١٥ فبراير و ١٥ أكتوبر في كلاً من عامى الدراسة ، وتم استخدام ثلاثة معاملات من الرش الورقي هي : (GA_3) بتركيز ٠,٢٥ ملجرام/لتر (T1) ، (HA) بتركيز ٠,٥٠ ملجرام/لتر (T2) و(GA_3) بتركيز ٠,٢٥ ملجرام/لتر + (HA) بتركيز ٠,٥٠ ملجرام/لتر (T3) بالأضافة الى معاملة الكونترول (T0).

وأظهرت النتائج أن الطراز البيئي أسيوط أعطى أعلى قيم لصفات طول النبات ،عدد الأوراق/ نبات، وزن الأوراق/ نبات ، وزن النبات الواحد(جم) ، النسبة المئوية لوزن الأوراق / نبات والمحصول الطازج (كجم/ الوحدة التجريبية) في كلا من موسمي الزراعة. كما أظهرت النتائج أن ميعاد الزراعة المبكر ١٥ فبراير أدى إلى زيادة في صفات النمو والمحصول في كلا من الموسمين. الرش الورقي بتركيز ٠,٢٥ ملجرام/ لتر من GA_3 أعطى زيادة معنوية لصفات النمو والمحصول.

وبناء على النتائج السابقة فانه من المقترح رش الطراز البيئي أسيوط بتركيز ٠,٢٥ ملجرام/لتر من GA_3 في ميعاد الزراعة ١٥ فبراير أدى لزيادة معنوية في صفات النمو والمحصول ومكوناتة في كلا من موسمي الزراعة.