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Original Research Article

Different Effects and Application of Methyl Jasmonate on *Triticum aestivum* L. by *aphid* Attack

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Abstract

Wheat (*Triticum aestivum* L.) widely grown in Pakistan during winter season. Aphid is one of the biological factors that inhibits seed germination and plant development. Methyl jasmonate is a plant growth regulator known to take part in defense responses against different types of stresses including Aphid attack. The current study was conducted to improve the growth of the wheat by the foliar application of Methyl jasmonate. Two wheat varieties (Shafaq and Gold) were be sown in plastic pots filled with 6 kg soil in each pot. After germination, wheat plants were treated with different Aphids. After three weeks of treatment data about survival percentage, root attributes, shoot attributes and nutrient analysis was be recorded using standard procedure. The experiment was be conducted under a complete randomized design (CRD) with three replicates and results was be deducted after statistical analysis. Different concentrations of methyl jasmonate (100 micromolar and 1mM) were applied to 20 days old wheat plant. *Rhopalosiphum padi* was allowed to infest the methyl jasmonate treated plants as well as non-treated plants. Control plants were covered with net and no concentration of methyl jasmonate were applied. Aphids were allowed to infest the plant for 48 hours, after that the plant from all treatments were sampled for all physiological studies. Methyl jasmonate treated plants as well as control plants were used for direct aphid population count after every week. Concluded results depicted that plants exposed to different concentrations of methyl jasmonate affected the root and shoot length, plant height which was further improved through MeJA supplementation.
Keywords: Methyl jasmonate, MDA contents, catalase, hydrogen peroxide, chlorophyll.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is going to be increase by 70% in 2050, due to the global demand and the need for human population and fiber. To overcome this target, the offering of grain must be increased (Akhter *et al.*, 2020). From the limited availability of area that is not cultivated land on the planet and the increasing environmental problems related to converting carbon rich forests and grasslands to cropland, the future rise in grain production is on the whole come from existing farmland (Elhamahmy, 2015). Wheat is the third largest cereal crop (after maize *Zea mays*, and rice *Oryza sativa*) grown on this Earth planet. In semiarid rainfed areas. Wheat is traditionally grown. The land is left uncultivated for the whole growing season and many performances of plough land are used to control weeds. This farming practice has been used in many arid and semiarid regions of the world, such as Australia, Northwest China, Northwest Eurasia, Central Africa and the North American prairies. It is believed that summer fallowing allows a large proportion of rainfall to be conserved in the soil profile, which is available for the crops grown in previous years (El-Nasharty, 2019).

The rough outer layer of wheat, wheat bran, has virtually little nutritious value but is high in fibre. Wheat protein, when combined with other meals, provides amino acids that are a good source of protein (Khan, 2002). Proteins that act as enzymes for growth and maintenance of tissues, such as cell division, nutrition transport, and water balance and energy supply, are biochemically dependent on amino acids (Srilakshmi, 2003). Depending on the growth climate, the protein level of the same wheat type might range from 7 to 20% (Elhamahmy, 2015).

As a result, proteins are the most essential components of wheat grains when it comes to determining end-use quality (El Dakak & Hassan. 2020). Protein quantity and composition have a substantial impact on flour quality. Although grain protein composition is predominantly determined by genotype, environmental conditions and their interactions have a considerable impact. Starch is the primary source of energy in human diets (Khan *et al*., 2012).

The endosperm, or interior component of the wheat grain, is mostly made up of 80 percent starch and is used as a source of energy. The outer layer of wheat grain (wheat bran) has minimal nutritional value and is largely made up of fiber. Starch is a major carbohydrate that can be used as a source of dietary energy during germination (Akhter *et al*., 2020). Hemicelluloses, cellulose, and free sugars make up the rest of the carbohydrate in the endosperm (Bashir *et al*., 2015). High temperatures during grain filling limit starch deposition, which has a negative impact on yield. During grain development, starch content rises. From 21 to 28 days, the maximum rate of building occurs, while crude protein and soluble protein levels also rise throughout grain growth (Dotania *et al*., 2014).

The current study was conducted to improve the growth of the wheat by the foliar application of Methyl jasmonate. After germination, wheat plants were treated with different Aphids. After three weeks of treatment data about survival percentage, root attributes, shoot attributes and nutrient analysis was be recorded using standard procedure.

MATERIALS AND METHODS

An experiment was be conducted to see how exogenously applied methyl jasmonate affects the properties of wheat (*Triticum aestivum* L.) infested by the English grain aphid (*Sitibion avenea* F.). To fill the plastic pots for the sowing of two varieties of wheat, Shafaq and Gold, thickly soil was be utilized. Two doses of methyl jasmonate was be employed as an exogenous application. Following the application of methyl jasmonate, the obtained data was recorded using various qualities from various phases. For the study of variance data acquired after 7 days of application, the CRD design was used. The properties listed below was be determined.

Sowing

In each plastic pot containing the prepared soil, 10 seeds of each variety were sown.

Treatments

In a set amount of time, two methyl jasmoate treatments were used.

Spray

A foliar treatment of two amounts of methyl jasmonate, 1mM and 100mM was used.

Data collections

The leaves were frozen at -30°C in order to assess antioxidant activity and other characteristics.

Morphological Data

Plant Height (cm)

Plant height can be measured by using meter rod. Plant height was calculated using the following formula:

Plant height= Shoot length + Root length.

Shoot Height (cm)

The length of the shoot was measured using the same meter rod. The mean of all the values was then determined.

Number of leaves per plant

By using common observation, the number of leaves per plant was determined, and the data was recorded.

Leaf area (cm^2)

To do so, measure the width of the leaf first, then the length of the leaf. The width of the leaf double the length of the leaf. The formula was as follows. Leaf area equals the maximum leaf width multiplied by the maximum leaf length multiplied by the correction factor.

Root fresh weight (g)

To begin, cut the plant's root from the plant and weigh the root using an electrical balance.

Root dry weight (g)

After determining the root fresh weight, the plant's roots were dried in the sun for 4-5 days. After thorough sun drying, the roots of the plants were placed in an oven set to 65 degrees Celsius for one week. Before properly drying the roots of the plants, weigh the weights again with an electrical balance.

Shoot fresh weight (g)

Pick up 2 or 3 plants for measuring the fresh weight of the shoots, then use the measuring balance to compute their weights.

Shoot dry weight (g)

After measuring the fresh weight of the shoots, the plant's shoots were dried in the sun for 4-5 days. After thorough sun drying, the roots of the plants were placed in an oven set to 65 degrees Celsius for one week. Before properly drying the roots of the plants, weigh the weights again with an electrical balance.

RESULTS AND DISCUSSIONS

Plant height (cm)

The data for plant height of two wheat cultivars, Shafaq-2006 and Gold-2016, is presented as an analysis of variance for both control and stressed (aphid) conditions with foliar application of MeJA. Plant height data from analysis of variance (ANOVA) revealed a highly significant variation across varieties. Plant height was significantly affected by aphid infestation. Both varieties of plants grew taller after being treated with MeJA. The interaction between variety and aphid, as well as the interaction between variety, aphid and MeJA application, was highly significant.

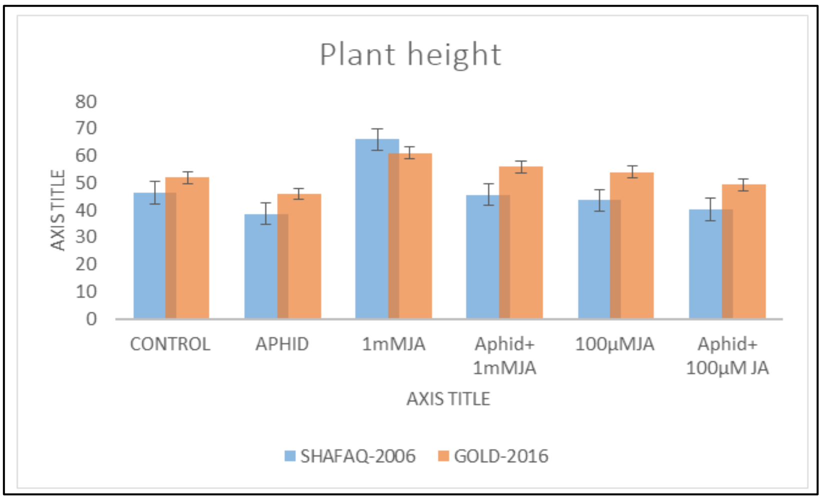

Fig-1: Plant height (cm) of two wheat cultivars grown in a controlled and stressed (aphid) environment with foliar MeJA application

The plant height of control plants is higher than that of stressed plants, according to treatment means. Plant height was reduced in both cultivars due to aphid stress. Under aphid stress, however, cv. Shafaq-2006 showed the greatest loss in plant height. The use of methyl jasmonate has a considerable impact on a variety of variables. Overall, cv. Gold-2016 outperforms cv. Shafaq-2006 under biotic stress with MeJA foliar application.

Root dry weight (g)

The data for root dry weight of two wheat cultivars, Shafaq-2006 and Gold-2016, is presented as an analysis of variance for control and stressed (aphid) conditions with foliar application of MeJA. The data from the analysis of variance (ANOVA) of root dry weight revealed that there was a highly significant difference between the varieties. Root dry weight was significantly affected by aphid infection. The use of MeJA enhanced the dry weight of the roots in both kinds. Highly significant interactions were found between variety and aphid, variety and MeJA application, aphid and MeJA application, and variety, aphid, and MeJA.

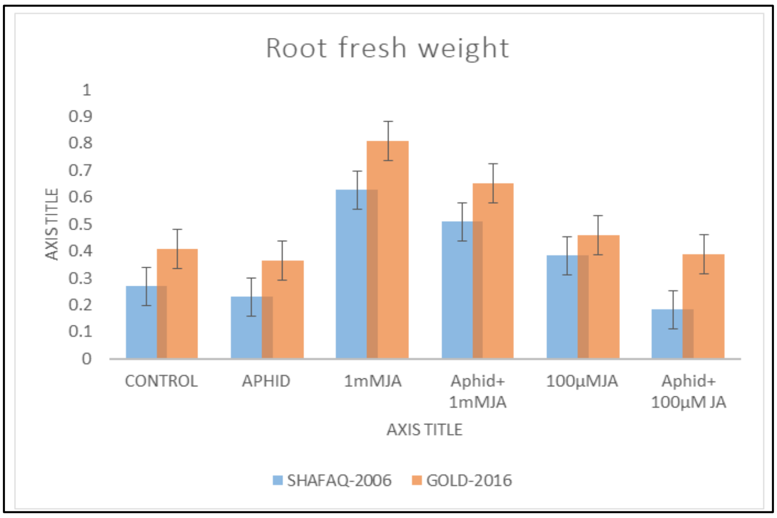

Fig-2: Two wheat cultivars were cultivated under control and stressed (aphid) conditions with foliar application of MeJA

The root fresh weight of control plants is higher than that of stressed plants, according to treatment means. Root dry weight was reduced in both cultivars due to aphid stress. cv., on the other hand, showed the greatest drop in root dry weight. Aphid stress on Shafaq-2006. The use of MeJA has a considerable impact on a variety of variables. CV in general. Gold-2016 is a superior performer than CV. Shafaq-2006 under biotic stress with MeJA foliar spray.

Shoot dry weight (g)

The data for shoot dry weight of two wheat cultivars, Shafaq-2006 and Gold-2016, grown under control and stressed (aphid) conditions with foliar application of MeJA are provided in an analysis of variance. An analysis of variance (ANOVA) of shoot dry weight data revealed that there was a highly significant difference between the varieties. The dry weight of the shoots was significantly affected by aphid infestation. The use of MeJA increased the dry weight of the shoots in both kinds. Highly significant interactions were found between variety and aphid, variety and MeJA application, aphid and MeJA application, and variety, aphid and MeJA.

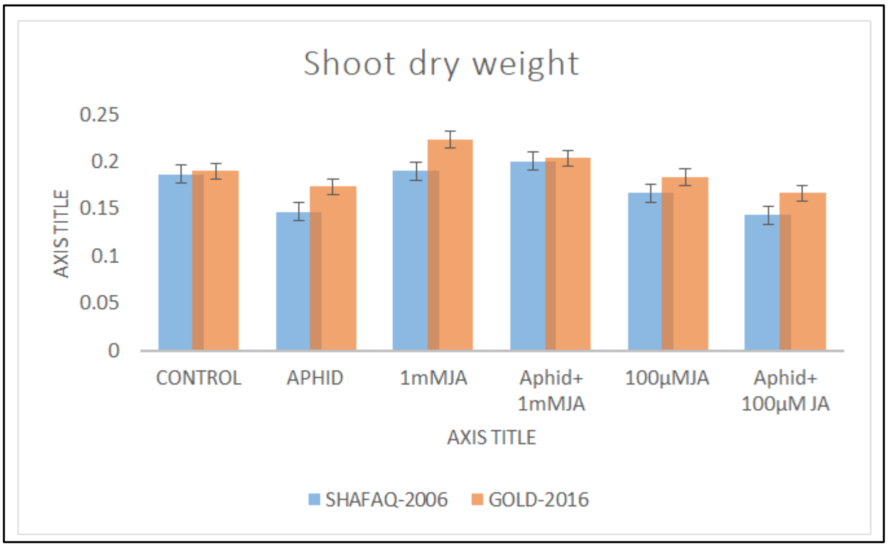

Fig-3: Shoot dry weight (g) of two wheat cultivars grown in a controlled and stressed (aphid) environment with foliar MeJA spray

The shoot dry weight of control plants is higher than that of stressed plants, according to treatment means. Both cultivars have lower shoot dry weight due to aphid stress. cv, on the other hand, showed the greatest reduction in shoot dry weight. Aphid stress on Shafaq-2006. The use of MeJA has a considerable impact on a variety of variables. CV in general. Gold-2016 is a superior performer than CV. Shafaq-2006 under biotic stress with MeJA foliar spray.

Root fresh weight (g)

The data for root fresh weight of two wheat cultivars, Shafaq-2006 and Gold-2016, is presented as an analysis of variance for control and stressed (aphid) conditions with foliar application of MeJA (Fig 4). The data from the analysis of variance (ANOVA) of root fresh weight revealed that there was a highly significant difference between the varieties. Root fresh weight showed a substantial variation due to aphid infestation. The use of MeJA improved the fresh weight of the roots in both kinds. The interactions between variety and aphid, variety and MeJA application, aphid and MeJA application, and variety, aphid, and MeJA application were all highly significant.

The root fresh weight of control plants is higher than that of stressed plants, according to treatment means. Root fresh weight was reduced in both cultivars due to aphid stress. cv., on the other hand, showed the greatest loss in root fresh weight. Aphid stress on Shafaq-2006. The use of MeJA has a significant impact on a variety of variables. CV in general. Paktoon-2016 is a superior performer than CV. Shafaq-2006 under biotic stress with MeJA foliar spray.

Root length (cm)

The data for root length of two wheat cultivars Shafaq-2006 and Gold-2016 cultivated under control and stressed (aphid) conditions with foliar application of MeJA are provided in an analysis of variance. The root length data from the analysis of variance (ANOVA) revealed a highly significant variation between the varieties. Root length was significantly different after an aphid infestation. In both kinds, Methyl jasmonate treatment improved root length. The interaction between variety and MeJA application was significant, as was the interaction between variety and aphid, as well as the interaction between variety, aphid, and MeJ application.

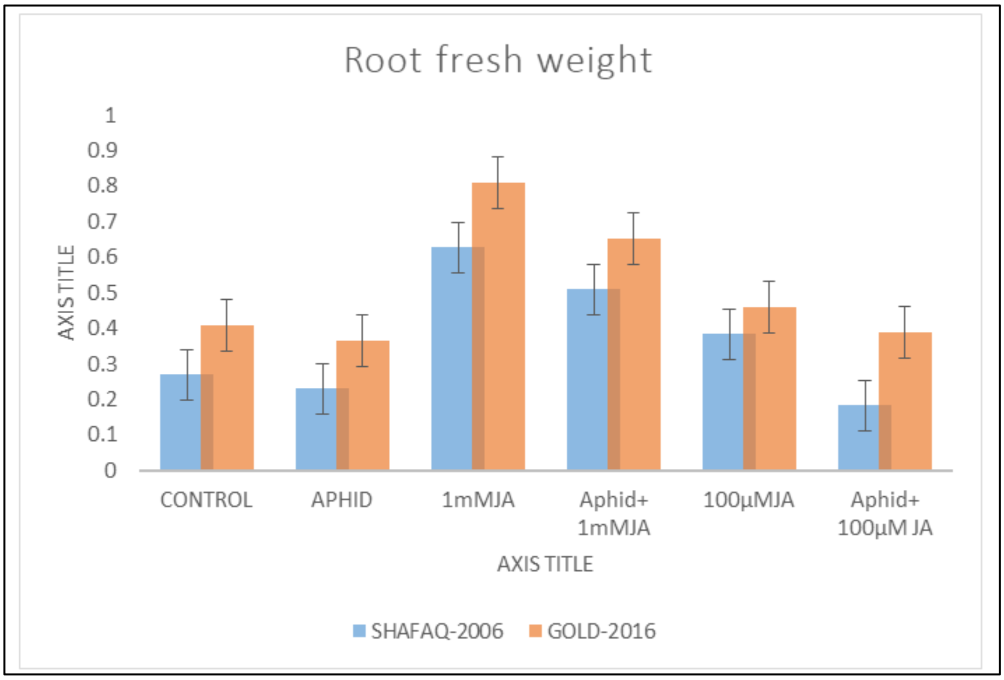

Fig-4: Root fresh weight (g) of two wheat cultivars grown under control and in aphid-infested conditions after foliar methyl jasmonate spray

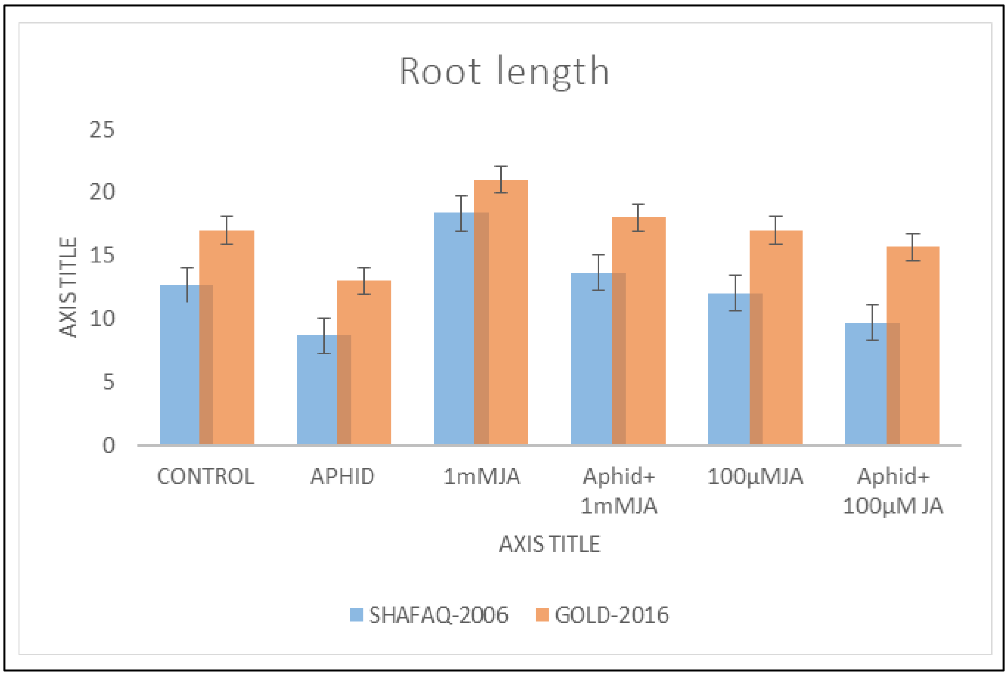

Fig-5: Root length (cm) of two wheat cultivars grown in a controlled and stressed (aphid) environment with foliar MeJA administration

The root length of control plants is longer than that of stressed plants, according to treatment means. Root length was reduced in both cultivars due to aphid stress. Under aphid stress, however, cv. Shafaq-2006 showed the greatest loss in root length. The use of MeJA has a considerable impact on a variety of variables. Overall, cv. Gold-2016 outperforms cv. Shafaq-2006 under biotic stress with MeJA foliar spray.

Shoot fresh weight (g)

The data for shoot fresh weight of two wheat cultivars Shafaq-2006 and Gold-2016 cultivated under control and stressed (aphid) conditions with foliar application of MeJA are provided in an analysis of variance. SFW data from the analysis of variance (ANOVA) revealed a highly significant variation between the varieties. Root length was significantly different after an aphid infestation. In both kinds, Methyl jasmonate treatment improved root length. The interaction between variety and MeJA application was significant, as was the interaction between variety and aphid, as well as the interaction between variety, aphid, and MeJ application.

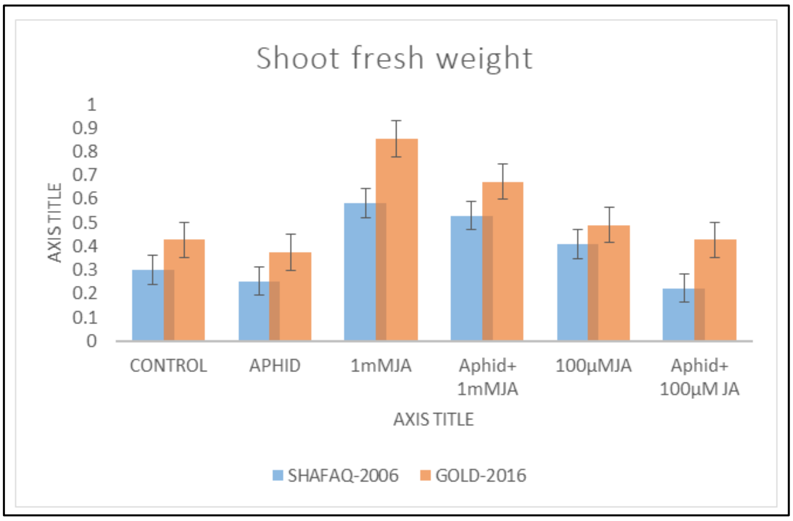

Fig-6: Two wheat cultivars were cultivated under controlled and stressed (aphid) conditions with foliar application of MeJA

The shoot fresh weight of control plants is higher than that of stressed plants, according to treatment means. Both cultivars have lower shoot fresh weight due to aphid stress. It showed the greatest drop in shoot fresh weight. Aphid stress on Shafaq-2006. The use of MeJA has a considerable impact on a variety of variables. Paktoon-2016 is a superior performer than CV. Shafaq-2006 under biotic stress with MeJA foliar spray.

Shoot length (cm)

The data for shoot length of two wheat cultivars, Shafaq-2006 and Gold-2016, cultivated under control and stressed (aphid) conditions with foliar application of MeJA are provided in an analysis of variance. Shoot length data from analysis of variance (ANOVA) revealed a highly significant variation between the varieties. The length of the shoots was significantly different after an aphid infection. In both kinds, MeJA treatment improved shoot length. The interaction between variety and MeJA application was significant, as was the interaction between variety and aphid, as well as the interaction between variety, aphid, and MeJA application.

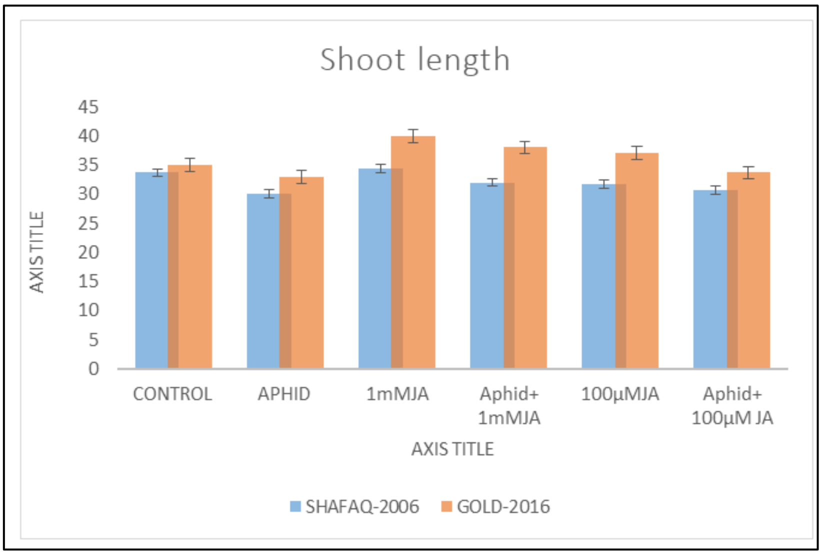

Fig-7: Shoot length (cm) of two wheat cultivars grown in a controlled and stressed (aphid) environment with foliar MeJA spray

The shoot length of control plants is longer than that of stressed plants, according to treatment means. Both cultivars had a drop in shoot length due to aphid stress. cv, on the other hand, showed the greatest loss in shoot length. Aphid stress on Shafaq-2006. The use of MeJA has a considerable impact on a variety of variables. CV in general. Gold-2016 is a superior performer than CV. Shafaq-2006 under biotic stress with MeJA foliar spray.

Carotenoid (mg/g F.Wt)

The data for carotenoid of two wheat cultivars, Shafaq-2006 and Gold-2016, is presented as an analysis of variance for both control and stressed (aphid) conditions with foliar application of MeJA. The data from the carotenoid analysis of variance (ANOVA) revealed that there was a highly significant difference between the varieties. The amount of carotenoid in the aphid infestation was significantly different. The use of Methyl jasmonate increased the amount of carotenoid in both kinds. The interaction between variety and aphid was considerable, and the interaction between variety, aphid, and MeJA was also extremely significant.

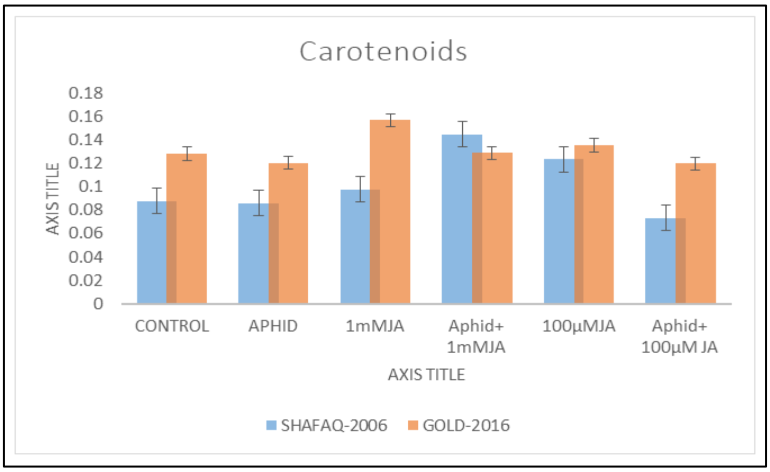

Fig-8: Carotenoid content of two wheat cultivars cultivated under control and stressed (aphid) conditions with foliar MeJA spray (Aphid)

The carotenoid content of control plants is higher than that of stressed plants, according to treatment means. Both cultivars have lower carotenoid levels due to aphid stress. cv, on the other hand, showed the greatest drop in carotenoid. Aphid stress on Shafaq-2006. The use of MeJA has a considerable impact on a variety of variables. Overall, cv. Gold-2016 outperforms cv. Shafaq-2006 under biotic stress with MeJA foliar spray.

Leaf area (cm^2)

The data for leaf area of two wheat cultivars, Shafaq-2006 and Gold-2016, cultivated under control and stressed (aphid) conditions with foliar application of MeJA are provided in an analysis of variance. The findings from the analysis of variance (ANOVA) of leaf area revealed that there was a highly significant difference between the varieties. The variation in leaf area due to aphid infestation was quite substantial. In both types, MeJA treatment increased leaf area. Highly significant interactions were found between variety and aphid, variety and MeJA application, aphid and MeJA application, and variety, aphid, and MeJA.

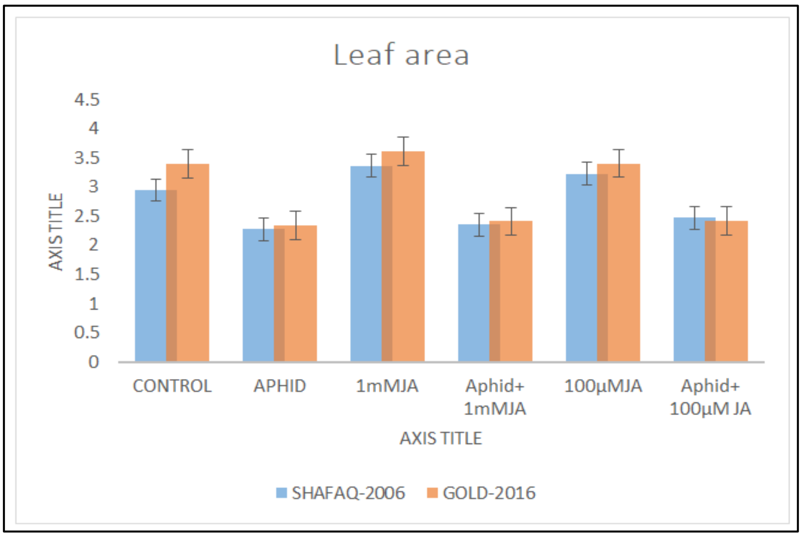

Fig-9: Leaf area (cm2) of two wheat cultivars cultivated in control and stressed (aphid) conditions with foliar MeJA treatment

The leaf area of control plants is greater than that of stressed plants, according to treatment means. Both cultivars' leaf area was reduced due to aphid stress. cv, on the other hand, had the greatest drop in leaf area. Aphid stress on Shafaq-2006. The use of MeJA has a considerable impact on a variety of variables. CV in general. Gold-2016 is a superior performer than CV. Shafaq-2006 under biotic stress with MeJA foliar spray.

Leaf number per plant

The data for leaf number of two wheat cultivars, Shafaq-2006 and Gold-2016, is presented as an analysis of variance for control and stressed (aphid) conditions with foliar application of MeJA. The use of MeJA enhanced the number of leaves in both kinds, according to analysis of variance (ANOVA) data.

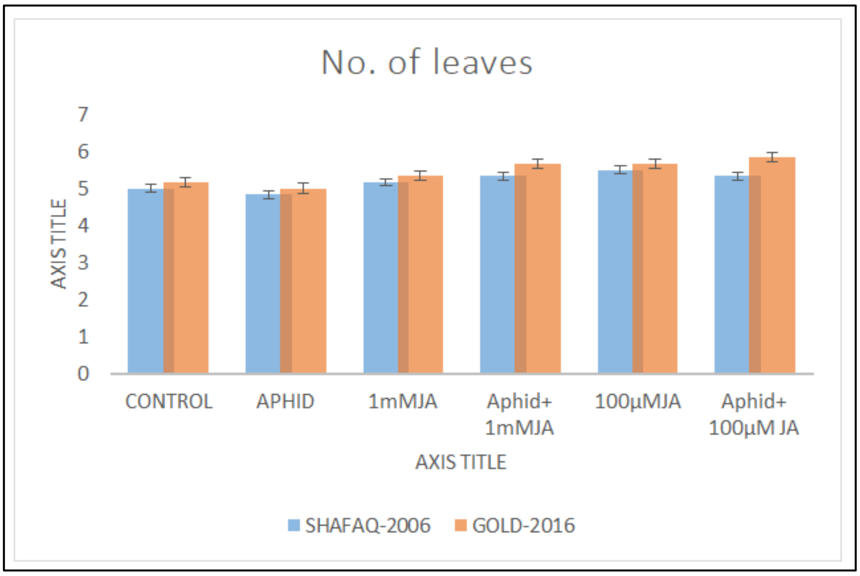

Fig-10: Leaf number of two wheat cultivars grown in a controlled and stressed (aphid) environment with foliar MeJA application

The leaf number of control plants is higher than that of stressed plants, according to treatment means. Both cultivars had a drop in leaf number due to aphid stress. cv, on the other hand, had the greatest loss in leaf number. Aphid stress on Shafaq-2006. The use of MeJA has a considerable impact on a variety of variables. CV in general. Gold-2016 is a superior performer than CV. Shafaq-2006 under biotic stress with MeJA foliar spray.

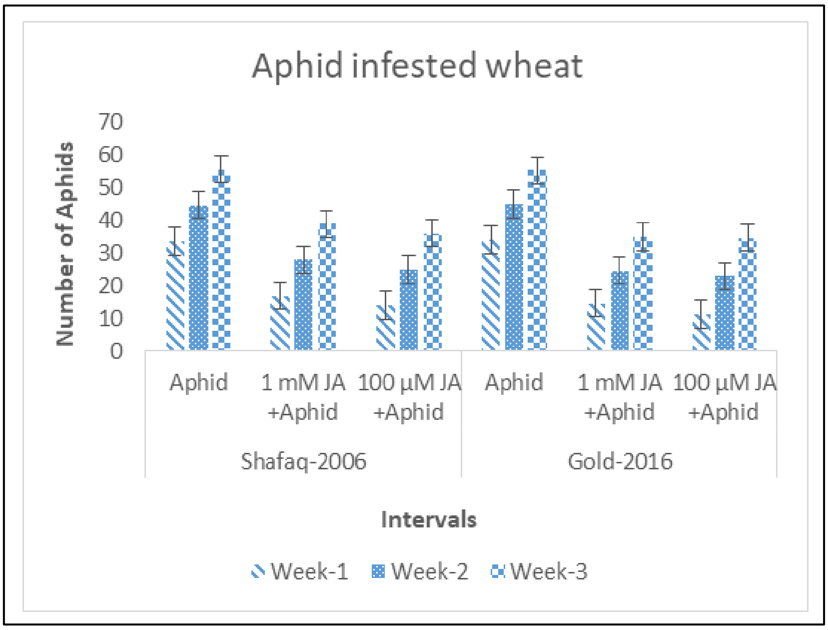

Fig-11: Aphid count of two wheat cultivars grown in a controlled and stressed (aphid) environment with foliar MeJA application

The aphid number of control plants is higher than that of stressed plants, according to treatment means. Both cultivars had a drop in leaf number due to aphid stress. cv, on the other hand, had the greatest loss in leaf number. Aphid stress on Shafaq-2006. The use of MeJA has a considerable impact on a variety of variables. CV in general. Gold-2016 is a superior performer than CV. Shafaq-2006 under biotic stress with MeJA foliar spray.

Grain storage is extremely important in both established and emerging economies. In Pakistan, inappropriate traditional and modern grain storage methods result in significant physical and chemical quality losses. In developing countries, proper grain storage is critical to the survival of their economies. When wheat seed is sown immediately after harvesting, the germination rate drops from 5.2-10.7 percent, according to the majority of the researchers. When grain was held for about five months, detected a 5-17 percent drop in seed germination. They also discovered that when seed is housed in concrete bins, seed germination is higher than when seed is stored in bins. Qiu *et al*., (2014) on the other hand, found that when wheat was stored in jute bags rather than bins, the quality of the wheat changed the most.

Today's food crises, usage of energy, damaging effects of natural resources, climatic effects and lifestyle of many people changed. Wheat is the second most important crop after the rice in dietary nutrition values. It is the source of proteins. It provides 20% of proteins and calorie count 21% to more than 4.5 billion people in different countries. The total grown area for wheat is 215 million hectares worldwide from equator to latitude and altitude that is ranged from sea level to more than 3000 meters.

Several wheat production areas having favorable environments for development of disease and susceptible to severe loss. Grain crops are being cultivated in many countries like Egypt, Syria, Israel, Pakistan and India. Nowadays the farming of Wheat has prolonged into Australia and America from the watered areas West of and South Asia. Due to the higher percentage of protein and digestible levels, wheat is important in farming systems for at least two reasons. The first reason is that it can fix atmospheric nitrogen, secondly, it has benefited over grasses due to animal feeding which results in more milk production du it is content of higher percentage of protein and a higher level of digestibility those two factors result in more milk production and increase animal growth rate (Hashmi *et al*., 2017). Providing food security for an ever-increasing population and reducing poverty while maintaining agricultural systems in the face of decreasing natural resources, climatic variability, rising input costs, and volatile food prices is the major challenge facing most Asian countries (Bhan and Behera, 2014). Intensive tillage also caused soil organic matter loss, soil structural degradation, water and wind erosion, reduced water infiltration rates, surface sealing and crusting, and soil compaction; and insignificant organic material addition, which are the main results for the main indicators of agricultural system non-sustainability, such as soil erosion, soil osmosis, and soil compaction (Bhan and Behera, 2014). As a result, getting out of the business as usual mindset in farming operations and avoiding unsustainable ways of traditional agriculture is critical for future productivity while also preserving natural resources.

CONCLUSION

Several wheat production areas having favorable environments for development of disease and susceptible to severe loss. Aphids (*Rophalosiphum padi)* infestation adversely effects the morphological traits such as root length, shoot length and plant height. While methyl jasmonate is a plant growth regulator which was used to accomplish the adverse effects of *R.padi*.

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