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Full Length Research Paper

Foliar feeding with Gibberellic acid (GA3): A strategy for enhanced growth and yield of Okra (*Abelmoschus esculentus L.* Moench.)

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Gibberellic acid (GA_3) is a naturally occurring growth hormone which controls the extremely important aspects of plant growth through regulation of several growth processes such as seed germination, stem elongation, uniform flowering, and increased number of flowers. Exogenous application of GA_3 hastens the vegetative and reproductive growth of plants. The current study evaluated the effectiveness of GA_3 applied as foliar application for enhanced vegetative and reproductive growth of okra. First foliar application of GA_3 (100 mg Kg^{-1}) was performed after 3 weeks from sowing while next three applications with regular interval of one week. Results revealed that the increase in number of foliar application of GA_3 substantially improved the vegetative as well as reproductive growth of okra comparing to control plants. It was found that application at different growth stages of okra predominantly boosted the stem elongation, number of leaves per plant, number of pods per plant, number of seeds per pod, seed weight and seed yield. Therefore it can be concluded that foliar application of GA_3 may be an effective strategy for maximizing the growth and yield of okra.

Key words: Gibberellic acid (GA_3), okra, plant height, vegetative growth, reproductive growth.

INTRODUCTION

Okra (*Albelmoschus esculentus* L) being a member of family Malvacea, a famous vegetable of tropical areas. It is used as vegetable in many regions of the world, especially in the developing countries (Tamura and Minamide, 1984). Okra possibly originated from east Africa, as it has been grown there for 4000 years. It is commonly cultivated in tropical or mediterranean climate for its fresh pods. It grows best in hot weather (temperatures above 26°C). The most important okra-producing countries are India, Nigeria, Pakistan, Ghana and Egypt.

Okra is used as fresh, cooked or as chemical addition to the soups, salads and stews. Because of its sensitivity to storage, fresh okras are preserved mostly by freezing or in some countries fruits are dried for later use. Okra provides some amount of vitamins, dietary fiber, energy and minerals (Adom et al., 1997).

Plant growth regulators like auxins, gibberellins and cytokinins are used in the agriculture for better growth and yield responses ultimately affecting crop production (Briant, 1974; Srivastava and Sachan, 1971). Gibberellins (GAs) mediate many responses in plants from seed

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germination to the senescence (Davies, 1995). The most widely available compound is a gibberellic acid (GA_3) which induces stem and internode elongation, seed germination, enzyme production during germination, and fruit setting and growth (Dijkstra and Kuiper, 1989; Ross et al., 1990; Davies, 1995).

GA_3 is a natural growth hormone and is a part of a type of plant hormones called gibberellins. GA_3 promotes cell division and a number of plant development mechanisms and encourages numerous desirable effects such as plant height, uniform flowering, reduced time to flowering and increased flower number and size (Srivastava and Srivastava, 2007). Foliar application of gibberellic acid modified also plant growth and pod characteristics (Asghar et al., 1997).

MATERIALS AND METHODS

Present research studies were conducted at Vegetable Research Area, Institute of Horticultural Sciences, University of Agriculture, Faisalabad, during Year 2008.

The experiment was laid out according to the Randomized Complete Block Design (RCBD). There were five treatments and each treatment was replicated four times. There were total 20 combinations in this experiment. Crop was sown on 2 of April, 2008. The plant to plant distance was 15.5 cm and row to row distance was 75 cm.

The 100 mg Kg^{-1} solution of Gibberellic acid (GA3) was applied by foliar application. There were five treatments T_0, T_1, T_2, T_3 and T_4. T_0 was control and received no foliar spray of gibberellic acid (GA3). T_1, T_2, T_3 and T_4 received 1st spray 3 weeks after sowing. T_2, T_3, T_4 received 2nd spray one week after the first one. T_3 and T_4 received 3rd spray one week after the second spray. T_4 received fourth and last spray after one week of the third spray.

Following traits were scored; plant height, number of leaves per plant, the number of pods per plant, pod length, number of seeds per pod, number of seed per plant, seed yield per plant (g), 1000 seed weight (g), germination percentage, percent nitrogen (%) (Chapman and Parker, 1961) and percent protein (%) (Sengkhamparn et al., 2008).

The data collected was statistically analyzed by the statistical package M Stat-C and was subjected to analysis of variance technique (Steel et al., 1997) and LSD test was applied to the data at a 5% significance level.

RESULTS

Results confirmed the efficacy of gibberellic acid (GA3) as a foliar feeding for enhanced growth and yield of okra. Data regarding the plant height revealed that the value of trait was manifold with the increase in application of gibberellic acid (GA3). Maximum increase in plant height was shown with 4 foliar sprays of GA_3 (T_4) (199.25 cm), while minimum plant height was observed in where no GA_3 was applied (T_0) (120.25 cm). Similarly, four foliar sprays of GA_3 (T_4) showed highest response in case of number of leaves per plant equaling 53 leaves. T_0 remained lowest with 44 number of leaves. In the same way data regarding number of pods per plant showed that maximum number of pods was produced with four foliar sprays of GA_3 (T_4) with 44 number of pods and minimum number of pods was produced in T_0.

It was also clearly observed that treatment where 1, 2, and 3 applications of GA_3 was applied produced better results comparing to the treatment where no foliar GA_3 was applied. However, four sprays of gibberellic acid created a prominent difference from control, as four foliar sprays of GA_3 (T_4) produced increased pod length (23.5 cm). All other treatments remained statistically at par with each other. But T_0 produced minimum pod length (16 cm) as compared to other treatments. Four foliar sprays of GA_3 (T_4) also produced maximum number of seeds per pod (75) and number of seeds per plant (2773.5) while control T_0 produced minimum number of seeds (34.25) and number of seeds per plant (745.5).

This premise is well supported by data regarding seed yield per plant (g) and 1000 seed weight (g) as four sprays of GA_3 exhibit the seed yield per plant of 168.25 m and 1000 seed weight of 53 g. Whereas, control produced seed yield per plant of 34.5 and 1000 seed weight of 48 m.

The foliar application of GA_3 substantially improved the quality of seed as four foliar sprays of GA_3 (T_4) showed maximum nitrogen percentage in seeds. Also the data collected depicts that four foliar sprays of GA_3 (T_4) gave maximum protein percentage (22.65%). Control remained minimum in protein percentage with (21.59%). After this, the seed germination ability was checked and the seeds which received four foliar sprays of GA_3 showed almost 90% seed germination confirming that seeds are healthy and of great quality.

DISCUSSION

In plants like okra there is indeterminate growth pattern which show vegetative and reproductive growth simultaneously. In this way, as okra shows this behavior, a continuous supply of nutrients and plant growth substances are required all the time. That's why four times foliar application of gibberellic acid (GA3) was done in all the duration of crop. Plant height was predominantly increased by the application of GA_3. Plant height is a very important factor for good plant growth and ultimate yield. Along with plant height pod length, number of pods, number of leaves and other vegetative and reproductive attributes were also affected. Most of the vegetative and reproductive growth parameters especially plant height (Figure 1) and number of pods boosted are similar to the findings of Ilias et al. (2007), Asghar et al. (1997) and Abdel-Mouty and El-Greadly (2008). Gibberellic acid GA_3 also stimulated nitrogen assimilation which affected the raw protein accumulation in okra seeds that is important for crops for seeds production.

Conclusion

At the end, it is recommended to use foliar feedings with

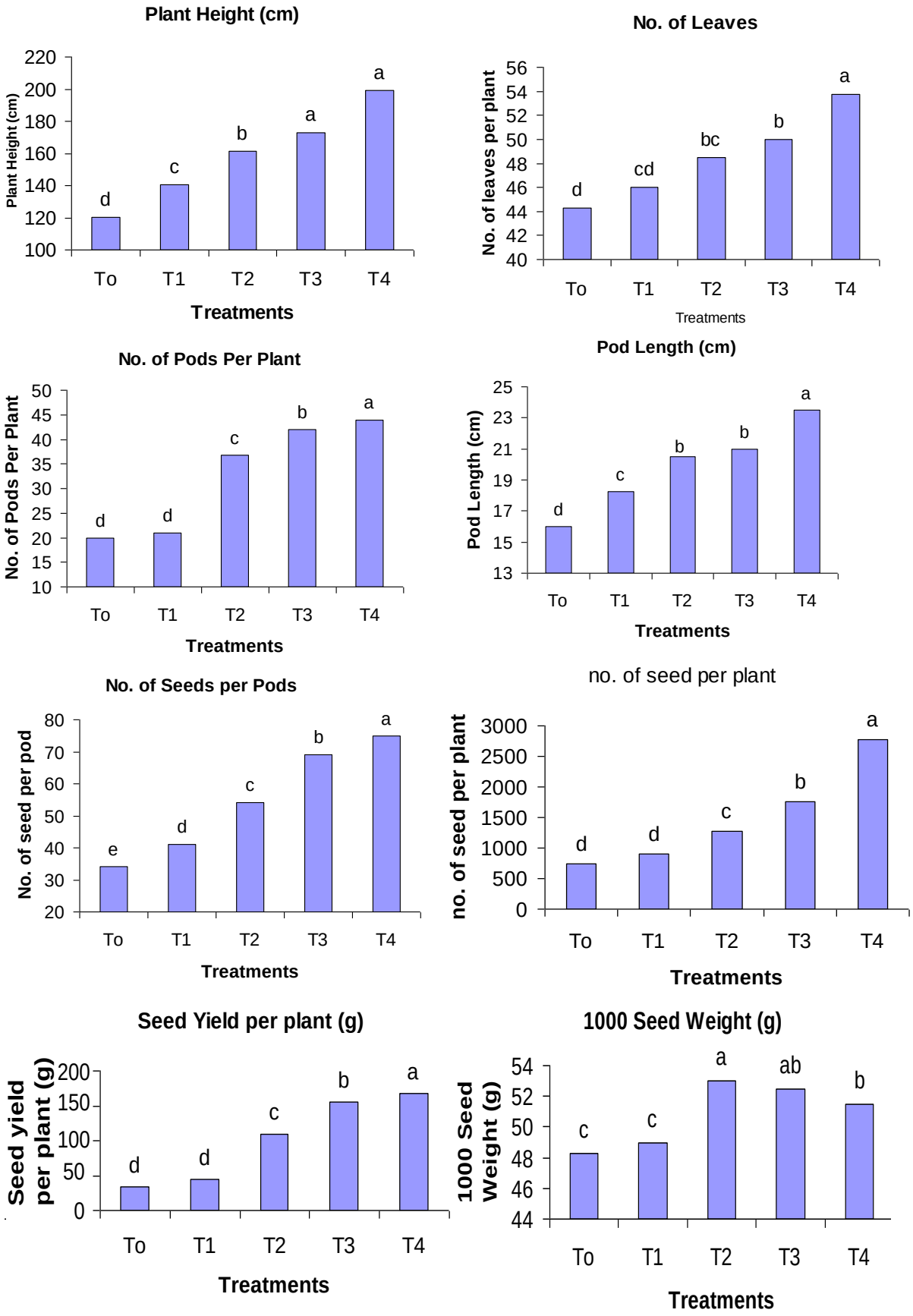

Figure 1. Effect of Gibberellic acid GA_3 on different parameters of okra plant.

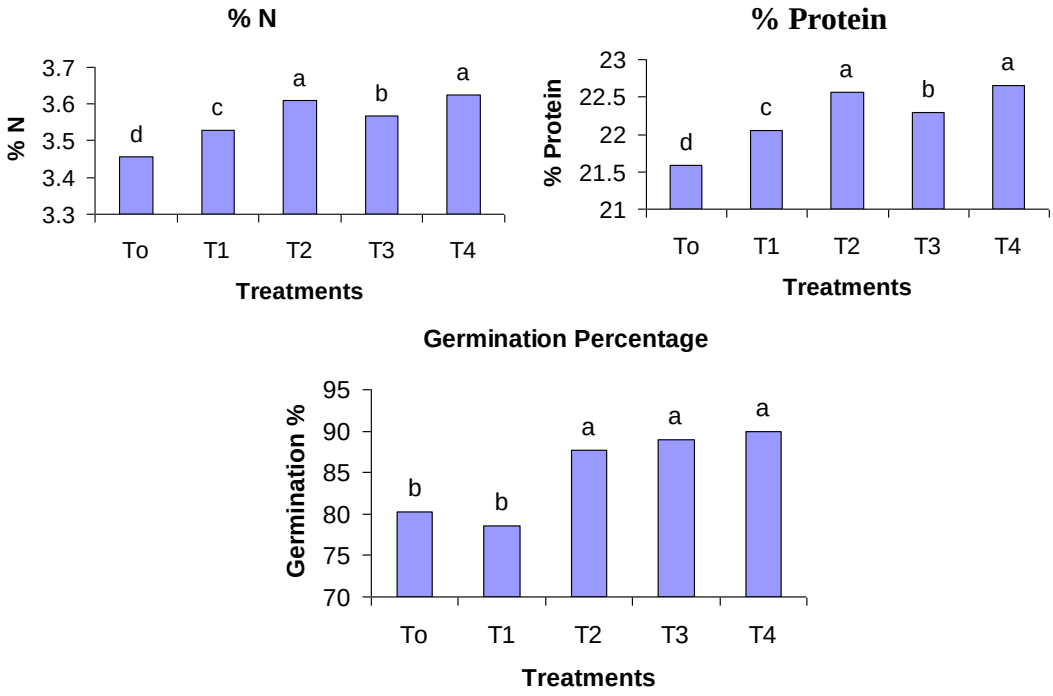

Figure 2. Effect of Gibberellic acid GA_3 on okra seed quality.

gibberellic acid to enhance the vegetative and reproductive growth of okra with quality seed production as well (Figure 2).

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